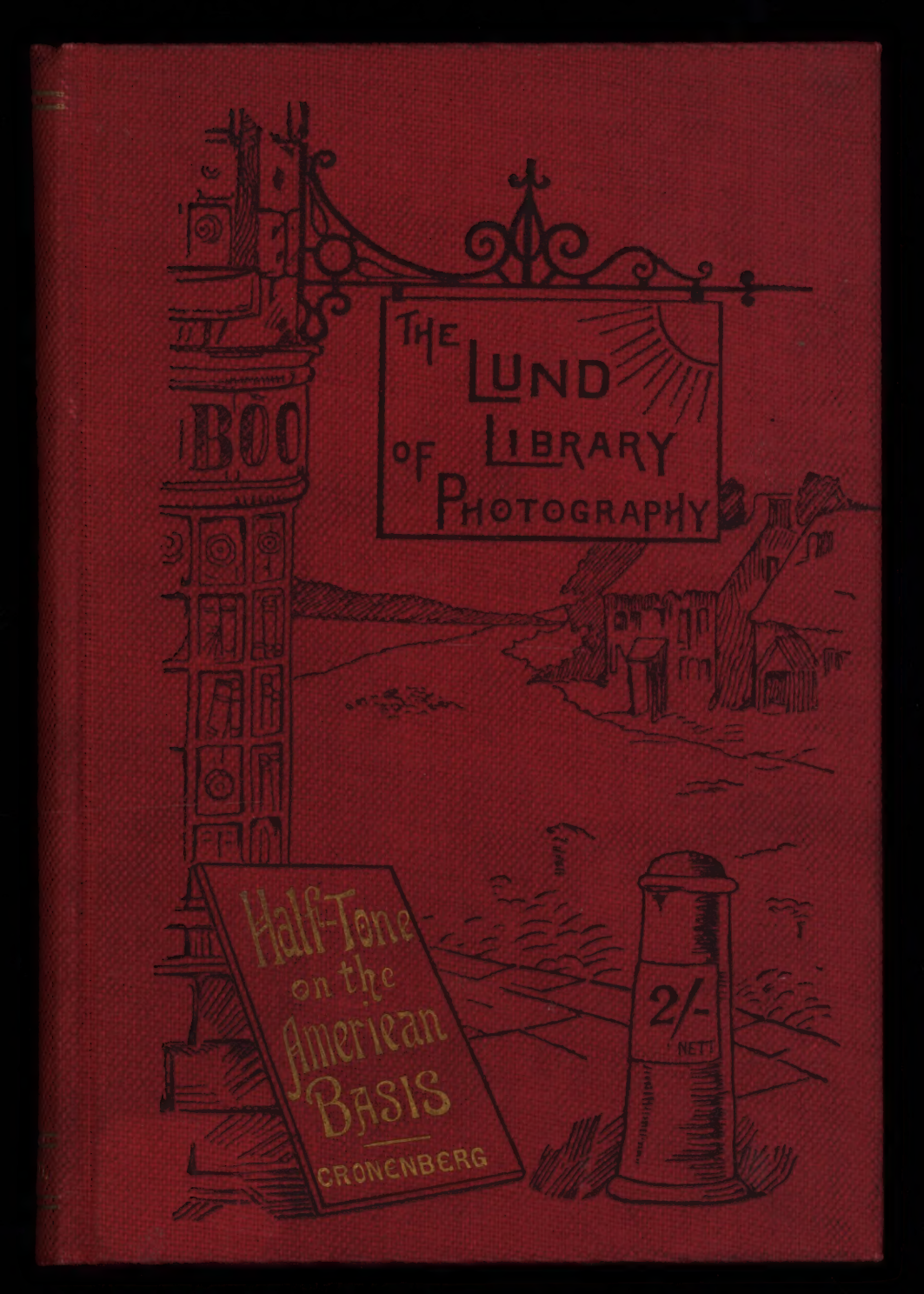
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HALF-TONE

ON THE AMERICAN BASIS

FROM THE PERSONAL EXPERIENCE

OF

WILHELM CRONENBERG

(Proprietor and Conductor of the Practical Institute for Photography and Mechanical Reproduction at Schloss Grönenbach, Bavarian-Algan.)

With 56 Illustrations in the Text and Twelve Supplement Illustrations.

TRANSLATED BY

WILLIAM GAMBLE

(Editor of "Process Work" and "Process Year Book.")

PERCY LUND & CO., LTD., THE COUNTRY PRESS, BRADFORD;
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CONTENTS.

PREFACE.

OF all methods of reproduction none deserve our attention in a higher degree than that of Autotypy, or half-tone, not perhaps because its results are of so perfect a nature—in this respect it stands far behind collotype and photogravure, and hardly approaches lithography—but rather in consequence of its speed in making a plate, and from a plate printing an edition, and its suitability in all respects for letterpress printing, whilst on these two grounds it is also cheap. Moreover, the productions of the half-tone process are well suited for distribution among the people as a cheap educational medium which will find entrance to every household, and by presenting in this way faithful copies of works of art will do more to disseminate knowledge than lengthy descriptions. We had long recognised the value of pictorial representations, and had sought a more decided method of mechanical reproduction for the

deservedly high-developed printing press, until Meisenbach solved the problem.

Look back to the earliest days of the process, which commenced so modestly and insignificantly, and consider the short space of time—not more than twelve years—that the young process has been developing, and realise the industry that has sprung up from the idea of one man. As yet we cannot see the end of these developments, for the process of Autotypy has only just been adapted to three-colour printing. A little space of time, and where now only the form is presented, sketched in grey monotone, we shall see the cheeks redden, the eyes reflect their prismatic sheen, the mouth display its purply lips, and Nature unfold the whole of her colour charms.

I have endeavoured in the present little book to leave out all matters of secondary importance, and have only described with amplitude the kernel of the process. As a practical man speaking to practical men I have found theoretical considerations of little value, but it seemed to me they could not be overlooked when—as in the chapter on the negative process—they were absolutely necessary for the understanding of the work. I also thought

it superfluous and only page-filling padding to describe the elementary process of Autotypy, and in this way dish up methods which have long since been consigned *ad acta*, and only distract the attention of the reader from essential to secondary things. Further, I have abstained from treating photographic operations, as such. Who would have the impertinence to attempt to write something new of a subject, on the practice of which there is already so extensive and excellent a theoretical literature? I have made it my principle in this little work to apply to no other source than my own practical experience, a rule in which I have been supported by noticing the often incorrect formulæ and directions given. On the other hand, I thought it my duty to give to Brother Jonathan the honour which he deserves as the foster father of Autotypy, and to speak as an authority of the arrangements and appliances I have seen there. As to the supplements to be found in this book, they are all produced in my studio school, and for the most part are the work of my students. This circumstance is to me more precious, as it proves that the principles of Autotypy which I teach to my students, and which have also been laid down in this book, are the

right ones, and that the efforts of those who hold to them must be at last crowned with success. In consequence of these favourable results I venture to hope that the following pages will not have been written in vain.

In conclusion, I must acknowledge the assistance of my students, by whom the whole of the illustrations in this work have been made, and to their teacher in the etching process, Herr C. Fleck, my best thanks are also given.

TRANSLATOR'S PREFACE.

WHEN consulted by the publishers as to the advisability of issuing a translation of this work, I was pleased to testify to its technical value. Herr Cronenberg has, moreover, considerable reputation on the Continent as a practical teacher of long experience in process work, and this fact alone would be a guarantee of its reliability. On account also of the fact that the book covers ground upon which there is a considerable dearth of information it will be welcome. The author does not pretend to be exhaustive in the treatment of this subject, and the inexperienced must not assume that the processes here described cover the whole scope of American photo-engraving. I think, however, it will be recognised by those who are familiar with American methods that it gives a fairly complete resumé of the principal processes, and the details given are sufficient, at least for those who have passed through the

elementary stages of process engraving, or who have practised the older processes, to enable the work to be carried out with successful results. There are some deductions and recommendations of the author's with which personally I should not agree, but I have not thought it advisable to interlard the book with foot-notes and detract from the work of the author, whose opinions as a careful and successful worker are entitled to thoughtful consideration. In the translation I have aimed rather to present the author's meaning in words intelligible to English readers than to adhere strictly to the text. If there is anything I have not made plain, I will endeavour to answer any brief questions sent me through the publishers.

WILLIAM GAMBLE.

London, January, 1896.

INTRODUCTION.

PHOTO-ENGRAVING IN AMERICA.*

New York! There it lies at my feet! I stand on the highest arch of the suspension bridge and cast my eyes on the beautiful scene before me. There flows past me the never-resting stream of traffic between the two great cities, New York and Brooklyn, thundering and tumultuous, but my glance rests on the distance from whence no sound penetrates, and where the glistening undulations of the crystal atmosphere have laid the soft veil of poesy on the blue waters of the port crowded with ships, on their countless masts, and on the far-extending sea of houses of America's greatest, richest, and most interesting city. Nothing disturbs the quiet charm of this striking picture. But by degrees, as the colossal arch of the suspension bridge plunges more and more into the heart of the city, the gables of the houses grow, the noise and

* Reprinted from the "South German Photographenzeitung"

tumult increases, the storm grows in strength, and the charm vanishes. Whilst on the top of the suspension bridge we were far removed from the every-day world, and gazed with an eye of idealism; here we now come to a picture typical of America —a scene of exciting, restless, hurrying industry. There is no place for Art, and no opportunity for the principles of beauty. In this sense-confusing wave of extremely competing industry, only one idea prevails, calling forth all the sharp-senses, all the spirit of perseverance, to profit by every advantage offered, in the annihilating war of competition in general, and in the battle of the individual, which is here carried on. All that is original, new, cheap, or beautiful, is thrown with uncomfortable speed on the market. To-day one possesses it, to-morrow it is the property of every one, and the day after it is superseded by a new invention and thrown into the lumber room. That this is not accomplished without the trumpet of advertisement is understood. Even the keen competition is one important factor by which this young country, in the course of a few decades, has attained such an unexpected height. Naturally, if this country demands constant innovation to impress the public, and secure a market for its products, its industries must profit thereby, and as the buildings in New York increase from storey to storey in height, so increases within the capability

of production in business. From day to day it is sought to simplify the present working processes, and to invent new mediums for accomplishing more work in a shorter time.

Could the circumstances be otherwise with the industry of reproduction? Twelve years ago, hardly more was known than the slow and expensive method of wood engraving. The mechanical reproduction by photography was still in its infancy, and etching in metal was almost unknown. The process of washed-out gelatine, and swelled gelatine were next introduced. The results were very beautiful, and these methods subsist even to the present day. They proved a dangerous enemy to the woodcut. It was soon found that instead of engraving on wood it paid better in many cases to draw upon a photograph in wood-cut style, and then bleach the photo out, the resulting drawing being converted by a mechanical process into a printing plate. The wood engraver was changed into a pen draughtsman, and in him originated an entirely new industry, which now gives employment to thousands of busy hands.

The swelled and washed-out gelatine processes were brought to a high state of perfection, enabling them to be worked with certainty. At the same time appeared the epoch-making innovation of Autotypy (the half-tone process). The success of this process has been remarkable, for here was a

method which dispensed with the draughtsman, working much quicker than the latter, and quite distinct from the wood engraver. Anyone who is familiar with the quickness and readiness of American business routine can easily conceive that the invention of the half-tone process was necessarily a more important advantage for America, than for slower-producing Europe. If we consider further that industry and commerce is everything there, and what is accomplished is mostly for these purposes, whilst for art and abstract sciences very little room is left, it is safe to conclude that the process of Autotypy was required in the service of industry for advertising purposes, and still serves to that end. Advertising in America is a very important word. Could we conceive an easier, quicker, or more beautiful process for producing a printing plate than by Autotypy. The existing methods of swelled and wash-out gelatine already employed for the purpose, even with inferior negatives produced by bad screens, obtained tolerable results.

It is only about nine years ago that the Moss Engraving Co., of New York, as the first and almost the only firm, nearly monopolised this process in New York and far beyond its borders. One can form some idea of the extensiveness of the business, when we know that only to finish the blocks, sixty-four men were employed as engravers.

At that time the swelled gelatine process was at its highest development and in its most flourishing state. Etching was nearly ignored, because it was at that time a rough and circumstantial method held in very little esteem. Yet despite the faulty screens, the inexperienced photographers, and defective means of printing, astonishingly good work was turned out. It was desired to imitate the woodcut by making the lines not diagonal—giving the same exposure to each set of lines—but disposing them parallel to the sides, and giving the horizontal a shorter and the vertical lines a longer exposure. By this means one obtained in the high lights definite points, but in the shadows horizontal lines, which by their up and down swelling were not unlike the long-trained or wavy lines of the woodcut. Whilst the half-tones produced in this way had the hardness of line work, they had also some similarity to the cool, hard colouring of the woodcut.

But it could not rest here. It was but the beginning of the business. Such half-tone blocks were expensive, but the high price was of minor importance, so long as the production of them lay in the hands of one maker. A much more serious inconvenience was the waste of time if quick delivery were desired. One could not wait two or three days, but might well do so for as many hours, and it was in this respect that the

etching appeared of advantage. In the latter process was found a helpful method of turning out urgent work. Then commenced a battle between the gelatine and the little-valued zinc. And much despised was the latter. For instance, the foreman of the swelling process department of the Moss Engraving Co., pointed to an etched zinc plate, a *portrait* in line work, and laughing ironically said: "What a beautifully dilapidated *landscape*!" Since then the times have changed very much, and the prejudice against etched work has turned to the contrary. With the improvement of the processes the time of production of the plates has become shorter and shorter, the work more and more beautiful, but the price has gradually become worse and worse. No one would use gelatine again except in certain cases. Out of fifty engraving establishments in New York, only one or two, so far as I know, work, besides the etching, the wash-out process. The swelled gelatine process has very properly been abandoned entirely. The establishments referred to use the wash-out process to make half-tone blocks, and accomplish admirable work. A third establishment has made use of the process until recently for the reproduction of large books, music, etc., but this work pays only in quantity at a price which is hardly half that paid for etching on zinc. Were we able to work even as quickly

or nearly so quickly as on zinc, so that the finishing of a plate, together with the necessary electrotype, would not exceed one day, then the gelatine could, in my judgment, compete with the zinc because of its cheapness, and in many cases its beauty. But the disadvantage remains of having to use dense negatives. Very often we are not able to make such a negative at all. Pencil drawings, grey lithos, drawings in pale washes of colour or ink, soiled, old, or yellowed paper, reproductions of prints in blue colour, or on red or yellow paper, or from very fine steel engravings, baffle all skill in obtaining at the same time a fine and yet equally dense negative. Besides, the advantage of zinc for the making of colour blocks is indisputable. All these causes turn the scale very heavily in disfavour of the wash-out process. Again, if an establishment be not very large, the existence of two radically different processes, requiring, moreover, double space, double arrangements, double labour and wages, brings only disadvantages, and the gelatine is, as we have pointed out, unable to exist alone under present conditions.

Therefore zinc maintains the field in this long battle, and has been used exclusively for the half-tone. But this did not prevent a stand being made at the last halting place in this process of development. It was left for copper and the alloys of copper to step in to meet the requirements of half-tone

etching. The density and even texture of the copper were recognised, as also its capability for polishing, the easy way of etching it, and its durability in printing. Here the firm of Moss has the credit of bringing copper first into general use. And when above all, in the enamel preparations, a direct copying method was found which for its beauty, its certainty, and its indestructibility, has quite outrun the albumen process, it is not surprising that the copper etching has found a place in every engraving business in spite of the fact that only three or four years have elapsed since the introduction of the process. Copper being in America very little dearer than zinc, there is not much to be taken into consideration, so that the cost of the metal plays no part in estimates of expense. What enhances the price of the metals most is the polishing, but this is mostly done by the etching firms in their own establishments. Besides this, very pure copper plates can be produced in an electrolytic way, so as to make the expense very trifling in an establishment having an electrotyping plant.

As to the interior arrangements of American engraving businesses, these are adapted to the conditions imposed by intense competition, and the work is carried on with the most reduced labour, in the smallest space, and with the simplest materials possible. The well-known American

principle of division of labour finds here also its full application and confirmation. The necessity of confining the workrooms to a very small space arises from the enormous value of the ground rents in large cities. The most space is wanted, of course, for the studio. The greater number are daylight studios, and we find them generally on the top floor. As most of the roofs are flat or with very little inclination a part and sometimes a large part of the roof is covered in with ground glass, which gives a free entrance to the light. Very often a part of the studio is without cover at all, and the work is done in the open air. On dull days which, of course, are more rare in the sunny climate of New York than here, the electric light in the form of arc lamps is made use of. In all branches of industry use is made of machinery, which fills the buildings from top to bottom with machines of the most varied kind, and which need a special system to supply the motive power. Large buildings intended for industrial purposes have their own engine standing in the basement. Some of them are of several hundred horse power, and these give by means of long transmissions the necessary power to the businesses on the different floors. If there is no steam power the steam is led from a central supply station into the surrounding buildings at a very low price. The gas meters of Otto Deutz are very

much liked. They can be set in movement at any time of day or night. The consumption of gas is regulated automatically according to the necessary power, and requires no supervision whatever. With the low price of gas in New York the expense of running these engines is unimportant, and one is entirely independent of outside eventualities. Cleaner, but expensive in establishment, as well as in cost of labour, is the use of electricity, for which the Edison Co. possesses the monopoly for New York, and exploits to the best advantage.

That there is much vibration with such a mass of machinery is a matter of course, and the violent shaking of the buildings makes a special and careful arrangement of the photographic apparatus necessary, especially as the studios are mostly on the top floor. Of all constructions the swing camera is the most approved, because of its cheapness, comfort, and the little room it requires. It gives to the American studio a typical character.

If several photographers have to work at the same time in a dark-room, it is of advantage to give the dark-room no door and to build an entrance in the nature of a rectangular tunnel, which excludes the light sufficiently for the wet plate process, and allows of the workers leaving and entering without hindrance. For sensitizing the plates dipping baths are generally used. The dark slides for half-tone work are notable for their con-

venience; they have not the troublesome extra carriers, yet they take every size of plate. The negatives are washed best, most quickly, and at the same time most economically under rose taps, from which the water flows with a strong pressure, but only plates prepared with albumen can bear such a heavy shower.

The division of work in large studios is worthy of attention. First the line and half-tone work is separated and placed in the hands of different operators, who have at their disposal a certain number of cameras and separate dark-rooms. In the half-tone process, which depends on very exact working and the utmost possible cleanliness, the photographer undertakes mostly the whole of the work up to the finishing of the negatives. For the taking of line originals very large firms have hardly more than two photographers, each of whom has several cameras at his disposal, and works them all at the same time. It is not uncommon to find good workers who, with the help of several boys, have five or six cameras in active use at once. One boy fastens the originals upon the copying board, another prepares the plates, and a third one intensifies them. The most important duties, such as the focussing, the right exposure, and the developing, the photographer undertakes himself, besides supervising the other photographic operations, and in this practical, and at the same time

economical manner, an enormous quantity of work is turned out without excessive expense, because the operations which cause the most waste of time are done by boys at low wages. Also for turning and stripping the negatives a boy is employed.

The studio, printing, and etching room are, of course, absolutely separated to keep the dust of the latter away from the first. On the arrangement of the room for direct printing there is nothing new to say. The essential features are: Whirlers and copying frames, of which there are a number of good make. The etching also is primitive. A heating stove composed of an iron plate heated underneath with gas, the etching tubs, dusting boxes, a stoneware or lead trough for potash solution, a few rollers and ink slab for occasional use, brushes, sponges, etc., makes up the whole arrangement.

The methods of etching are radically different from those customary in Germany. First of all, rolling-up and covering in with ink, and also the deep or finishing etch is omitted. The maximum time allowed for etching a line plate of fair size, say, for instance, of 14 × 18 inches, must not exceed, with a good worker, two hours, whilst urgent and small-sized work has to be etched in half or three-quarters of an hour. Deep etching is compensated for by the routing machine, which has been naturalised from the commencement of photo engraving. Besides the router there are running

a host of other machines, of which the most important are the circular saw, the polishing machine, the wood trimmer, the bevelling machine, and the drilling machine.

Much care is taken in the selection of hand printing presses; the most preferred being the Washington Press. The art of proof-taking has obtained a high degree of perfection, and good provers are well paid. Mechanical printing has not been introduced, perhaps because of the original unevenness of the plate and the further inequalities made purposely by the burnisher of the engraver, which renders special hand pulling necessary.

Perhaps it will be interesting to many to know the average wages earned by workers employed in an engraving establishment in New York, but as a matter of course we do not refer to exceptional salaries. A capable half-tone photographer earns from £5 to £7 a week; a line photographer £2 10s. to £3 10s.; a printer, well up in albumen and enamel process, £2 10s. to £3 10s.; an etcher in line and half-tone on zinc and copper, £3 to £4; boys for washing the glass plates, making silver prints, or otherwise employed in the studio, copying or etching room, earn from 12s. to 30s. according to their knowledge and qualification; a retoucher for negatives or prints, £2; capable engravers, knowing how to cut vignettes, £4 to £5; line engravers, £3 to £3 15s., and the same for

provers. A man working the routing machine gets £2 15s. to £3 10s.; a blocker, who fastens the plate on to the blocks, £2 10s. to £3: a plate polisher, £2; and a carpenter, £3

The price paid for blocks has dropped in the last few years very low, and the golden time in this branch belongs to the past. The competition is overwhelming. It should be remembered that in the City of New York alone there are more than fifty establishments. By all of them beautiful and rapid work is done, but thus the public is spoilt, and the customer screws his claims always lower. Notwithstanding this, it must be said that photo-engraving is flourishing. We must not forget the requirements, not only of the huge population of three millions in the city, but also of the inland States, from whence many orders come. Furthermore, the methods of working have been more and more improved, the workers becoming more accustomed to the routine, whilst with the improvement of the businesses within, the aptitude for production has grown, so that against the low prices for the blocks a cheaper rate of production can be opposed. The average price for blocks in line is about 3½d. to 5½d. per square inch; those for half-tone, irrespective on what metal they are engraved, 1s.; and for vignettes the price is 1s. 3d. per square inch. For plates of very small size a minimum is charged.

CHAPTER I.

APPARATUS FOR NEGATIVE MAKING.

Alike in all photographic and photo-mechanica processes the negative is the most important factor for obtaining a good ultimate result, and the production of a succession of good negatives of all subjects taken in hand requires the utmost care, skill, and intelligence. In the same way the reproduction of an original by the half-tone process also depends for its success for the most part on the quality of the negative. Once in possession of a good negative the subsequent processes are easy. In consequence of this fact the centre of gravity in an establishment is in the arrangement of the photographic department, and by reason of the importance of this part of the work no expense is spared.

The first requirement in a studio intended for working the half-tone process is a strong and even light, and the best is where there is free entrance of direct sunlight. I know many of the establish-

ments in New York, but I cannot say that they possess any particularly practical feature in the arrangement of their studios. Nearly all of them are in the highest part of the building. To obtain light a large part in the roof, which is only slightly inclined, is cut out and the opening filled in with more or less transparent or ribbed glass. Sometimes the studio is very high, so that though there may be a considerable area of glass only a small amount of light reaches the floor. In this case a proportionately high platform is built up. Several establishments have cameras permanently on the roof so as to work by dull light in the open air. All deficiency of daylight is met by the electric light, and we could not conceive of a rational establishment without this illuminant. The lamps hang between the cameras, in front of the copying board, and are of 1500 to 4000 candle power. They are provided with reflectors to illuminate the original evenly. Instead of hanging the lamps they are sometimes supported on moveable stands (figs. 1 & 2) so that they can be placed in front of the original in any desired position. One or two establishments work without daylight and are wholly dependent on artificial light. If the electric light is not so strong as good sunlight it has nevertheless the advantage of being much more constant than daylight. The electricity is sometimes taken from the mains, but other establishments

generate it on the premises by means of dynamos.

The reproduction establishments being, as before mentioned, in the highest part of the buildings,

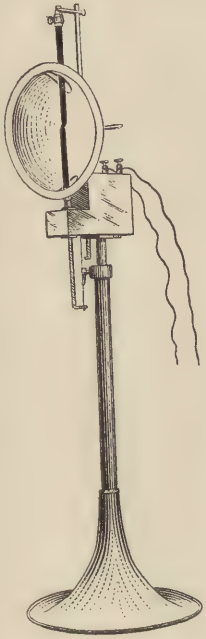

Fig. 1.

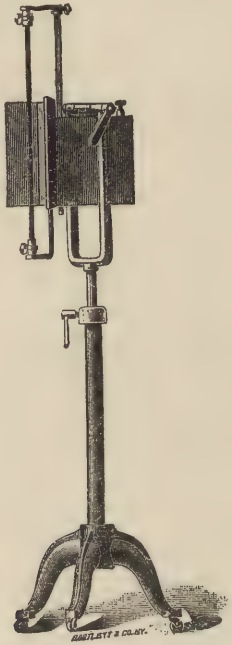

Fig. 2.

which are sometimes ten to nineteen stories high, it occurs that in such colossal buildings where machinery of 100 to 400 collective horse power are running, that there is a continual vibration, and

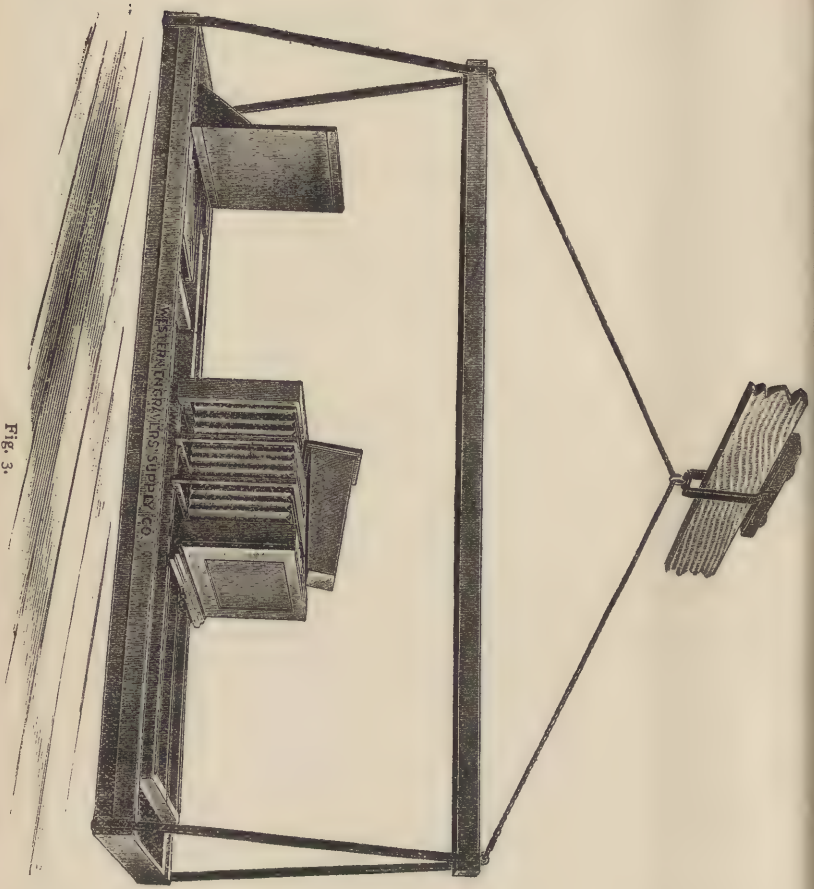

Fig. 3.

this requires a special and careful arrangement of the camera stand. Of the apparatus in use the hanging or swing camera is the most favoured, and fig. 3 shows the most popular shape. Close to the glass roof and running parallel with it is a rafter or iron bar, and the cameras are at such a

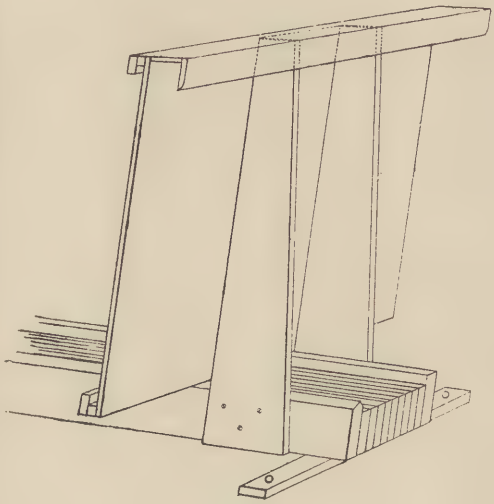

Fig. 4.

distance from one another that an easy movement of the operator is possible. The bed on which the camera is moved to and fro is composed of a long rigid frame (fig. 3), or of narrow planks of dry wood placed on edge (fig. 4). The length depends

on the focus of the lens used and the size of the originals, ranging between eight and twenty feet. On one end of the frame is the copying board for the originals to be reproduced; it may be movable or fixed, and is a flat board running in a groove. It keeps its position by means of a spring. To place the original quickly under glass the arrangement illustrated in figs. 4 and 5 is used. On the top and bottom edge of the copying board are two channels formed of long strips of wood. To mount the original the board is taken off, and laid down, the drawing being then placed in position, and a thick piece of plate glass put upon it. Two narrow strips of wood of the same length as the board and with tapered ends are laid over the edges of the glass plate at each end, the tapered ends being under the groove at the top and bottom of the board, where they are fastened with small wedges. The pressure of the wooden strip is sufficient to hold the glass plate when the board is brought to its vertical position. This arrangement is so easy and quick to handle that it seems to me worth

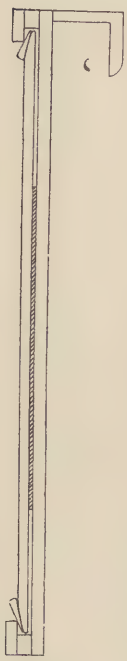

Fig. 5.

describing. Care must be taken to avoid the light coming direct from the front, otherwise a reflection on the glass is unavoidable. The frame on which the camera stands is suspended with four iron bands or wire rope to a second beam of the same length, but of very little breadth, in order to avoid as much as possible the formation of a shadow on the original, and the whole swings free on a wire rope hanging from the iron rail or rafter. As the centre of gravity changes by shifting the camera on the swing, the base is kept a little sloping, to allow the light to fall as much as possible vertically on the original, and a running weight of about 100 lbs. is attached to a tightly extended wire rope running the whole length underneath the base of the camera. Such a swing arrangement destroys all vibration. The camera can be directed as required to the light, and no blurring is to be feared through anyone knocking against the swing. It is even of advantage when using the electric light to keep up a swinging movement to avoid reflections or uneven light. Other constructions seek to avoid vibration by means of springs and indiarubber bands. Figs. 6 and 7 give representations of these arrangements. The last one I know by my own experience, and have tested by working it for a long time. One establishment in New York uses a peculiar kind of floating or water-balanced camera, but I do not know anything particularly about this

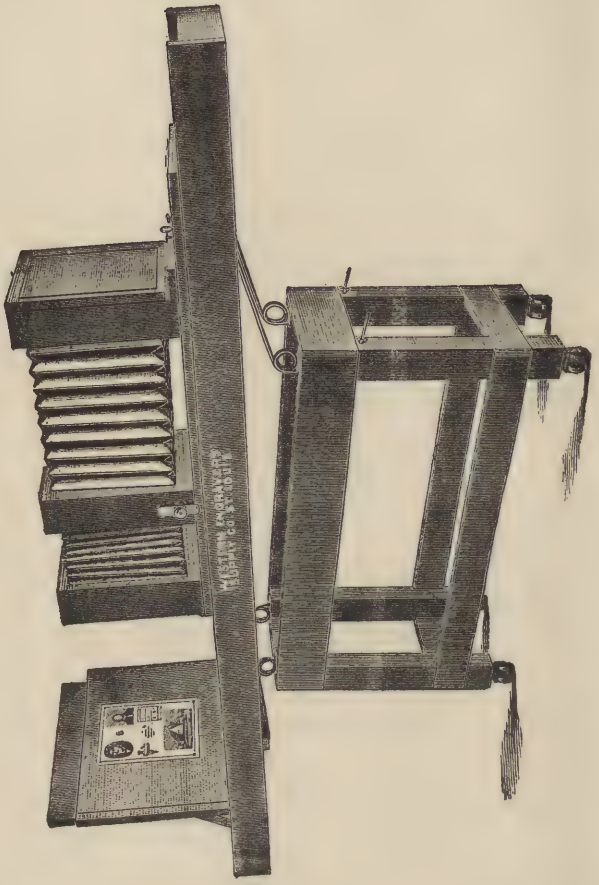

Fig. 6.

construction. Under all circumstances the swing is unsurpassed for its cheapness and simplicity, and I cannot see any reason for preferring any other system.

Besides the camera, the construction of the dark slide is of great importance. A good dark slide for half-tone work must have the following features. It must be possible to make use of the

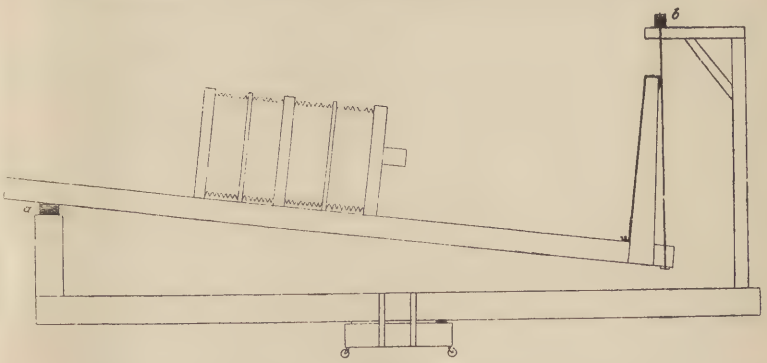

Fig. 7.

full size of the screen, and of the negative, within the size of the camera. The screen and plate must stand quite parallel and not closer than 1 mm. distance one from the other. Otherwise the silver finds its way into the cementing of the screen. Further it must be possible to easily regulate the distance of the plates without shifting the focus and parallelism. There has not been made until now any dark slide having all the qualities required,

and many establishments are satisfied with very simple arrangements. Certainly the process can be worked with an ordinary dark slide, but the chances of obtaining a good result are lessened, whilst such makeshift means, with the resulting failures, combined with the vexation and disappointment of the worker, makes one consider the price of a suitable half-tone dark slide not too high. If an ordinary dark slide is used for half-tone the necessary distance from the wet plate is obtained by interposing strips of cardboard or by fixing drops of wax at the corners of the screen, and after focussing to rack in to the extent of the thickness of the screen, plus the chosen distance, towards the front. This is the most simple and not the worst of half-tone dark slides. Of course, the size of the wet plate must not exceed that of the screen, and the screen cannot be used up to its full size. Besides, in the matter of sharpness, the shifting of the ground glass does not allow of very sure working. Should it be desired to avoid shifting the focus, the position of the carriers taking the screen and negative must be changed in such a manner that the screen is held in a deep rebate by means of springs, and is pushed up again, the four silver corners holding the negative. Little pieces of cardboard fixed on the corners enables the regulation of the distance to be made.

To use the full size of the screen, the size of the sensitive plate must exceed the screen in every way by about an inch. Both the screen and the sensitive plate must be separately fastened in their respective positions. As things are, the use of carriers has no particular advantages. Without considering the number of them which have to be always at hand for the different sizes, they are always warping and shrinking, owing to the weather and temperature, and for half-tone purposes, where exact parallelism is needed, this renders them almost useless. Besides they bend very easily by the pressure of the springs, and cause soiling of the screen by silver, even if not sticking to the collodion film. This inconvenience is avoided in America by the generally used Benster and Bonanza dark slides, which arrangement fig. 8 illustrates. The cogwheel movement in the Benster dark slide is not necessary, the cross-piece on which the plate rests being fixed in the desired position by means of notches (fig. 9). The top cross piece moves in grooves up and down. All sizes within the frame can be used with these dark slides. If a screen holder is placed between the sensitive plate and the shutter of the dark slide we have then a dark slide for half-tone answering very well for the purpose. The most perfect half-tone dark slides up to date are Levy's patent. They permit the use of different sizes of screens

and plates, and the distance is regulated by an outside arrangement. This dark slide is in a certain measure a double Benster dark slide, the arrangement for the screen holder being the same as for the negative. An ingenious adjustment

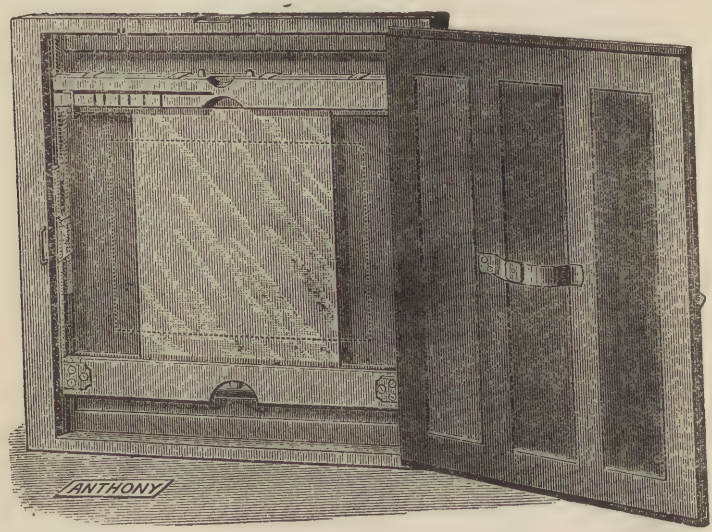

Fig. 8.

system, which is worked by two buttons from the outside of the dark slide, enables the distance to be varied to about 1 cm., and also to be enlarged whilst exposing, a circumstance which will be referred to later. Ingeniously as these dark slides are constructed they are not,

to my mind, entirely satisfactory. On the one hand such mechanism is so much more easily subject to deterioration, the more complicated it is; on the other hand, because such an exactness of parallelism as the use of a half-tone screen requires,

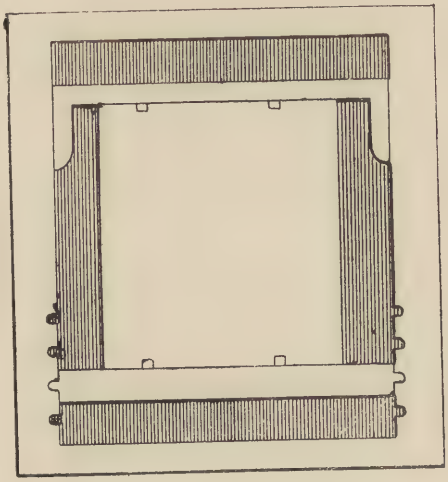

Fig. 9.

exceeds any demand that can reasonably be required of a camera maker, and because the screen cannot be brought closer to the wet plate than determined by the mechanism. It is always better to have a hand one's self in the regulation of the position of the screen. This can be done by the

arrangement illustrated in fig. 10 and 11. It shows in principle a simplified Levy dark slide, with the difference that the fixing of the screen is obtained by four movable screws.

Of all necessaries for half-tone work the matter of the screen claims the highest interest; and with good reason, for nothing exercises a more lasting influence on the result than does the screen. Now that in Europe the paper

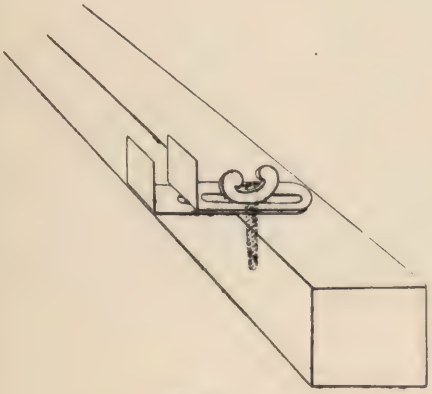

Fig. 10.

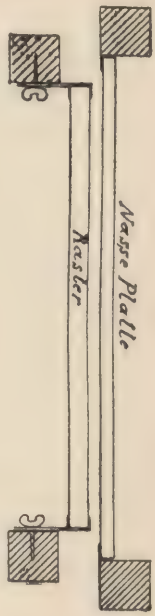

Fig. 11.*

screen seems to be in the dying out stage, it is useless

* It not being easily possible to alter the German words on this diagram block, it may be stated here that "Raster" is Screen, and "Nasse Platte" Wet Plate.—TRANS.

to waste words over this rudimentary process. The progress of half-tone is intimately associated with progress in the manufacture of screens, and we can only speak of the consequences of laying aside the paper screens, and of the work since the use of original glass screens or copies of them began. All the progress in the printing and etching processes, in the education of a new school of special operators, and in the training of etchers and proofers, have not contributed so much towards raising the interesting and beautiful half-tone process to the high position which it now occupies in America, as has the progress made in the production of suitable screens. With these, stands or falls the half-tone process. We have given up the single lined screens which had to be crossed during exposure, and the question as to the proportion of black and white lines has also been decided. Not less has experience taught us to what degree of fineness the screens may be used without asking more of the printing press and ink and paper than they can render. Since it has been possible to obtain good screens comparatively cheap, the half-tone process has made unexpected progress, giving a flourishing life to many establishments.

The most preferred and most appreciated are, very rightly, the glass screens of Max Levy, of Philadelphia. So far as the patented process of the manufacture is known, faultless polished plate glass

is coated with an etching ground—perhaps composed of asphalt, indiarubber and turpentine—and ruled in one of Levy's improved line machines, by means of a suitably ground diamond, the surface of the glass being bared. The machine must not be interrupted in its progress for a moment, as every interruption leaves a perceptible fault in the regularity of the ruling and spoils the plate. Of course, everything depends on the composition of the coating, in fact, upon it depends the fineness and sharpness of the lines. The diamond cuts through the coating without injuring the glass, and the plate is afterwards exposed for a short time, about two minutes, to the action of fluoric acid. After removing the coating, the plate is covered with a black film, and the excess of colour afterwards removed by means of a polishing machine so that the black remains only in the etched parts. Two plates with their lines crossed are then cemented together with Canada balsam under hydraulic pressure, and after grinding the edge the screen is finished. As a matter of course such screens if carefully handled are very durable and not easily attacked by silver. As a rule the thickness of the transparent and opaque lines are the same, or does not exceed the proportion of two of the latter to three of the former. These screens are manufactured in all sizes and shapes, and vary between 75 and 240 lines to the inch. They are of unsur-

passed transparency and sharpness, and only one who has never handled a Levy screen would say that screens etched with fluoric acid have ragged lines. Whilst original screens are preferable to copies, Wolfe, of Dayton, Ohio, nevertheless, makes good screens produced by means of collodion dry plates, and these are much below the price of Levy's. Many establishments in America use these screens exclusively, and the results obtained with them are hardly to be distinguished from those obtained with original screens.

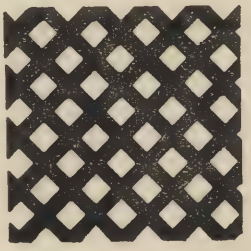

Fig. 12.

From the way of manufacturing these screens it will be understood that they are composed of a network of black lines, crossed at right angles, forming square transparent openings (fig. 12). Until now this kind of screen has been used with advantage for the half-tone process, and my subsequent remarks will relate only to this type of screen. I may mention, however, that screens have been made which are the negative of the beforementioned, having rectangular crossed transparent lines and opaque squares; also a system of round opaque dots on a transparent ground, or the contrary, transparent grain on an

opaque ground. To obtain more modulation from a flat original, Gaillard recommends screens composed of two engraved plates, each with semi-opaque single lines, which are sealed together. By this means a three-fold tone is obtained—transparent, semi-transparent and opaque—the points where the lines cross having a double density. These different forms of screens are almost altogether discarded, as they are for the most part without advantage over the American screen, even if the execution were faultless to the same degree. But the method of exposing through a single line screen, and after the first half of the exposure turning the screen for 90 degrees, is of importance, and has been practised until recently by large establishments with the best results, till at last even there the crossed screen conquered the field.

Whoever finds himself in the position of having to decide on a screen should for general work not get anything finer than 150 lines to the inch nor coarser than 75. On the one hand, by working with fine screens the difficulties of the process increase enormously, and the prints from the blocks on the machine do not turn out in most cases so well, except when the best paper and the most expensive ink is used. On the other hand, with coarse screens there is too much loss of fine detail. The following are the prices of the various makes of cross-lined screens :—

Original Engraved Screens of Max Levy, Philadelphia.

Sizes in inches.	Lines per Inch 75, 80 or 85.	100.	110 or 120.	125 or 133.	140 or 150.	166 or 172.	200.
6 × 8	£3 2 6	£3 15 0	£4 3 6	£4 12 6	£5 10 0	£6 15 0	£8 7 6
6½ × 8½	3 15 0	4 3 6	5 0 0	5 17 6	6 15 0	8 7 6	10 8 6
7 × 9	5 0 0	5 5 0	6 5 0	7 10 0	8 15 0	10 8 6	13 11 6
8 × 10	6 15 0	7 6 6	8 15 0	10 0 0	11 5 0	14 3 6	17 2 6
9 × 11	7 7 6	8 7 6	11 10 0	12 10 0	14 12 6	17 15 0	20 17 6
10 × 12	8 7 6	10 17 6	15 0 0	16 15 0	19 16 6	23 0 0	27 2 6
11 × 14	12 10 0	16 15 0	20 17 6	24 0 0	28 2 6	31 5 0	37 10 0
12 × 15	16 15 0	21 17 6	28 2 6	30 17 6	37 10 0	41 15 0	48 19 6
13 × 16	20 17 6	27 2 6	34 12 6	39 3 6	43 15 0	51 2 6	62 10 0
14 × 17	26 2 6	34 7 6	41 15 0	47 18 6	57 7 6	62 10 0	78 2 6
15 × 18	33 10 0	41 15 6	50 0 0	57 7 6	68 15 0	78 2 6	
16 × 20	39 12 6	50 0 0	58 7 6	68 15 0	78 2 6		
17 × 21	47 18 6	59 7 6	68 15 0	78 2 6			
18 × 22	57 7 6	67 15 0	80 5 0				

Original Screens of Edm. Gaillard, Berlin.

Size in inches.	Lines per Inch. 85.	100.	125.	133.	150.
6× 8	£4 0 0	£4 3 0	£4 10 0	£5 0 0	£5 15 0
7× 9½	5 16 0	6 0 0	6 13 0	7 10 0	8 0 0
8×10	7 0 0	8 5 0	9 2 0	11 2 0	12 0 0
10×12	8 0 0	11 4 0	15 0 0	16 10 0	20 10 0
12×16	17 5 0	22 10 0	27 10 0	31 10 0	37 10 0
16×20	40 10 0	51 0 0	60 0 0	66 0 0	72 0 0

Collodion Dry Plate Screens of M. Wolfe, Dayton, O.

	80, 100, or 124 lines.	132 lines.	148 lines.
10× 8	£4 3 6	£6 5 0	£8 7 0
12×10	6 5 0	10 8 6	10 8 6
15×12	16 14 0	20 17 0	—
15×15	20 17 0	26 2 6	—
14×14	—	14 12 6	—
13×13	10 8 6	—	15 12 6
14×11	10 8 6	16 14 0	—
16×16	26 1 0	31 5 0	—
16×14	20 17 0	26 1 0	—
18×18	36 9 6	41 13 4	—
18×15	31 5 0	36 9 6	—

Screens are also made in my instruction establishment from original American ones by photography and sold at one penny per square centimetre.

Every original can be reproduced by the half-tone process, but not all give equally good results. Indian ink or sepia drawings, good and clean photos, burnished, but not with high gloss—nor cracks nor spots (particularly if of a yellow or greenish nature)—and with detailed shadows, can be beautifully reproduced. In retouching, the work should be broad in effect, without going into minute detail, and in this way one can learn to brighten up a bad original by washes of colour. The most difficulty is experienced with dirty skies in landscapes, and damaged backgrounds in portraits. In such cases the parts are painted over with white pigment, or they are cut out and the picture pasted on white cardboard, or white paper is pasted over the sky and the contour, with such projections against the sky as lightning conductors, leaves and branches of trees, etc., drawn in. It is entirely left to the taste of the artist to insert clouds or smoke from the chimneys, to put in lights, introduce figures, or work up shadow detail, giving the picture a more picturesque and lifelike appearance. Delicate modelling in the lighter tones, such as the folds of drapery is almost lost in reproduction, but through retouching a stronger effect may be produced. It is further recom-

mended to burnish badly mounted photos, or in the case of cracked albumen prints to rub them with glycerine. If unmounted and crumpled photos are sent in they should be squeegeed down like gelatine pictures on to collodionized glass, receiving thereby a high brilliancy. They may be copied through the glass or pasted on to it like a cardboard mount. Of photographic papers the collodion is the most advantageous to use on account of its unusually clear and detailed shadows, its exceedingly sharp detail and its structureless film. It is not absolutely necessary to tone the pictures, but it is preferable, because it increases the brilliancy, the intense red of the untoned prints prolonging the exposure very much. Originals in line can be copied with the screen very well, and give plates of highly artistic feeling.

One word on lenses suitable for half-tone. The light has to pierce the thickness on the screen and to diffuse behind it, whilst contrary to line copying, where clear lines only have to act, the shadows have also to reflect so much light on to the sensitive plate that a fine, but dense dot is produced. Lenses giving poor illumination are therefore not suitable. An ordinary rapid rectilinear landscape lens renders good service. In general, quick-working lenses giving with large apertures an evenly-illuminated, well-defined, and not too soft picture, are the most suitable.

CHAPTER II.

THE NEGATIVE.

I turn now to the description of the most interesting and important part of the work, namely, the production of the negative. I presume that the operator is in possession of a not too hard-working collodion, as well as a strong and perfect silver bath, and is well acquainted with the handling of wet plates. Until gelatine plates can be made which are as rich in contrast, transparency and sharpness, and can be developed, intensified, and dried in the same time as wet plates, there is no hope of using them for half-tone work. Any collodion is suitable that will work clear and strong, and it is superfluous to give a new recipe. Every operator swears by his own formula. In reality the success depends less on the composition of a determined solution than upon an intimate knowledge of its qualities, and the extent of the practical experience of the operator.

The demands of a half-tone negative are of a varied nature. It is similar to an ordinary portrait or landscape negative, in that it must be exposed, developed and printed, but the half-fone negative must be also treated in accordance with the following processes to which it is subject. It has not only to render the high-lights, half-tones and shadows of the original in their relative tone value, but within these limits it has to take into account the conditions imposed by the making of the printing plates. If the process of making them is by etching, then it is evident that the lights of the negative have to be more open, because the etching liquid strives to round off and reduce the dots. It is quite indifferent whether a short first etch is given, the surface of the plate representing the picture being then protected with resin against the action of the etching solution, and then deep etched, or whether the plate is etched through in one bath. In the latter case the encroachment is not prevented, it is even preferred that the dots in the lights etch a little finer. The negative has to take these circumstances into account.

Suppose the negative has to be printed on to chromated gelatine and the latter washed out, it follows from the action of the light, with the necessarily prolonged exposure, and the conical penetration of the rays, that to print the dots large, the negative should be as far as possible rich in

contrast and plastic in the high-lights. If we consider further that in the electrotype made from the gelatine relief the shadows come always a little more shallow than in the matrix, this circumstance has to be accounted for by giving detail to the shadows. The differentiating of the negatives can be pushed much further by taking into consideration the fact that the zinc produces clearer, and somewhat harder proofs than copper, which print softer and fuller in tone, but differences are so imperceptible that while a photographer may talk about such distinctions he cannot carry them through practically, because other much more important difficulties require his whole attention.

Besides the considerations of modelling, and the applicability to block making, the negative has to accomplish a third condition, the complete breaking up of the tones into sharp, black, opaque dots and lines. A perfect half-tone negative must be free from all greyness, unsharpness, or veiling in the dots. Next to the deepest shadows, which for the most part have to be left transparent without dots, there should commence to form a fine, sharp, black dot, the size of which increases in the middle tones, until in the high-lights it joins by a ragged line to its neighbouring dot, producing a clear opening, and spreading in the highest lights into increasing size (fig. 13).

In the production of such negatives, in which the three requirements are fulfilled of faithful rendering of the original, adaptation to the method of block making in use, and the exact breaking up into black and white, there are some hypotheses to be noted, which I will proceed to explain.

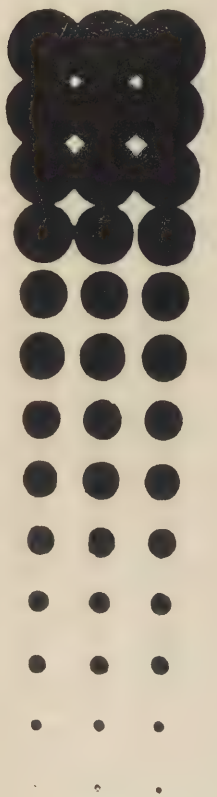

Fig. 13.

If a bundle of rays of light falls perpendicularly on the plane of a slit, we observe on a screen placed behind and directly opposite to it, not the sharp image of the slit which we perhaps expected, but a lighter centre, surrounded by a darker zone, the light of which decreases to nil towards the borders. That is to say, the motion of the light which reaches the slit creates there new waves of spherical form, which spread beyond the opening, and in this manner produce the veiled images of the slit. Let us suppose, now, the half-tone screen as an

accumulation of numerous slits, through which the light falls on the sensitive plate; the same appearance of light distribution will happen here. From every opening in the screen comes forth a diverging bundle of rays of which the maximum of light lies in the centre, corresponding to a central point, with a darker fringe on the sensitive plate. With the strength of the light the divergence increases or decreases, and by the uneven illumination of the screen, dots are produced, not only of different intensity, but also of different size. There is formed on the sensitive plate not only the reversed image of the screen, with equally large but unequally intense dots, as we might at first surmise, but actually there is attained in the camera a picture in dots, and as the dots come together by increasing in size, these are lines of different size and thickness, yet formed by means of a network with openings of the same size.

Result of Differently Distancing the Screen.—The possibility of the rays diverging behind the screen presupposes a certain distance between the latter and the sensitive plate, and it is clear that by increasing or decreasing this distance a change takes place in the size and the sharpness of the dots. The greater the distance, the more opportunity has the cone of light to diverge on its way from the screen to the sensitive plate (see fig. 14), but at the same time the dots lose their sharp-

ness. On the other hand, by decreased distance dots of greater sharpness and smaller size are formed, and if the distance is nil—that is to say, if screen and sensitive plate are in contact—an unevenly graded negative will be the result. It is evident that the original to be reproduced can be rendered with a different appearance according to the chosen distance. If the original has very deep

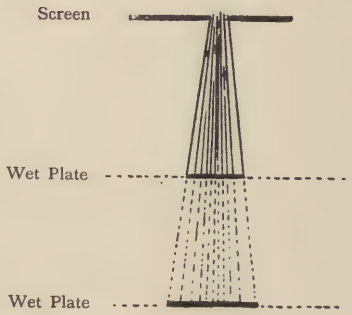

Fig. 14.

shadows and chalky lights, it is advisable to keep back the diffusion of the lens by decreasing the distance. Naturally, the detail of the shadows can only be obtained by prolonged exposure. But this does no harm to the lights, because here, in consequence of the short distance, the excess of exposure is more to the advantage of the density than the divergence or joining up of the dots. Whilst we have at hand, in this way, a means of softening

contrasts, this can also be augmented by increasing the distance. This is to be preferred with a soft flat original. But we must take into consideration that increase of distance goes hand in hand with a prolongation of exposure. Behind every opening in the screen extends a conical ray of light, which, by diffusing over a larger surface, naturally increases in intensity. The latter is just what is desired in the lights. That, in spite of prolonged exposure, the shadows remain clear, is also partly caused by the dispersal of the light. In this process, where we have to work with an already feeble light action, the dispersal of the rays further weakens the effect; this results especially when using a greater distance. Should we thus require an action of the light to take effect in the shadows, a prolonged exposure is necessary. The choice of increased distance is further advised generally if the process of printing requires strong negatives, rich in contrast, with closed lights; for instance, in the swelled gelatine and wash-out gelatine process, and in the case of many enamel preparations having strong relief. The dots in the lights of the negative round off more, and it is relatively easy to obtain an evenly dense closing up between the dots. Good strong light is requisite, so that we have not to give a disproportionate exposure, when it is necessary to use small stops, to which I shall refer later on. With feeble light it is not possible

to break up the shadows sufficiently, and it will always give, with a large distance of the screen, a hard negative.

The Effect of Different Sizes of Stops and the Focus of the Lens.—The position of the screen is not the only means available of modifying as desired the character of the negative. A more simple and certain method

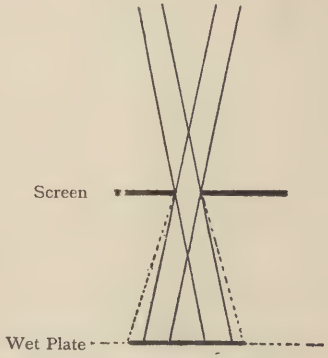

Fig. 15.

is to take advantage of the circumstance that different sized stops, by equally long exposure, produce different sized dots. If the light passes through the full aperture of the lens, the angle of incidence is greatest, but gradually decreases by the use of smaller stops. If we now interpose in the path of the rays a screen through which the light passes in straight lines, but diverges

on the other side, the angle at which the light strikes the screen and passes through its openings must influence the result. Nearly parallel rays, such as pass through small stops, will produce less spreading action behind the screen than rays coming more obliquely from large stops, these latter being further diffracted behind the screen, as

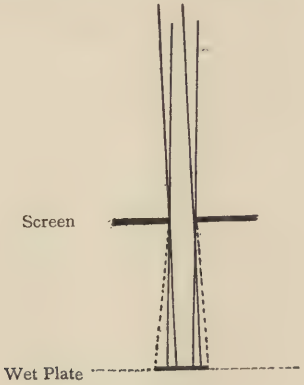

Fig. 16.

will be seen in figs. 15 and 16. Besides this, the sideways spreading behind every opening increases with the strength of the light. From these two facts, as well as the general experience that small stops produce soft, and large stops harder negatives, it follows that by changing the diameter of the stops a different effect in the half-tone negative is produced. In fact, negatives exposed through

large stops, even with a short exposure in proportion to the diameter of the stops, give more contrast than those exposed with smaller stops, and one is able to obtain by proper choice of stops every desired modification of strength or softness in negatives from hard or feeble originals. The action of the stops can be summed up in the following words: Small stops give the shadows, and large stops give the lights. We have, therefore, an action equivalent to placing the screen at different distances, and the operator has at command a most effective means of breaking up the tones, and inducing the modulation of the dots. The choice of suitable stops for the purpose is, therefore, of primary importance.

For the same reason—viz., that the rays fall at an oblique angle—lenses with short focus give more contrast than those with long focus. One must, in this case, work, as a rule, with a shorter distance between the screen and sensitive plate, or use a smaller stop, a circumstance which has to be taken into consideration when working new and unknown lenses.

The Action of Different Shapes of Stops.—The appearance of the dot in the half-tone negative is influenced by two factors, namely, in a slight measure by the shape of the opening in the screen, and in a far greater degree by the shape of the stop. Suppose the screen and the sensitive

plate are in contact, there is produced in the negative a dot of exactly the same shape and size as the openings in the screen. As we have already seen, the dots undergo from different causes, with increasing distance of the screen, changes in size, and not less is the shape altered, indeed, if we examine a negative exposed with an ordinary round stop we find besides the reproduction of the drawing of the original not square black dots but perfectly round ones. For the explanation of this appearance we must conceive an aperture of the screen, placed at a certain distance from the sensitive plate and from the stop, as forming the system of a pinhole camera. The dots on the negative are, indeed, nothing else but minute images of the opening in the diaphragm. By using other shapes of stops, variously shaped dots will be the result, but it will be noted from my subsequent remarks that in consequence of the lateral spreading behind the screen the dots always tend to approach a circular shape. To carry out some beautiful experiments on this point a piece of tissue paper is fastened over the lens, and the camera exposed directly towards a window. According to the desired size of the dots a longer or shorter

Fig. 17.

exposure is given through stops cut out of paper.

If a square stop (placed in a position corresponding to the openings of the screen) is chosen, the action is very little apparent, the dots preserving essentially their spherical shape, but an evident tendency will be perceptible towards a prolongation in the direction of the corners of the stop. If we make a square stop with the sides a

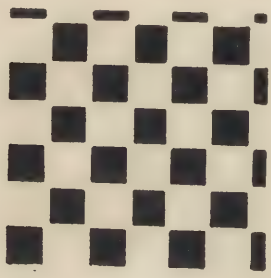

Fig. 18.

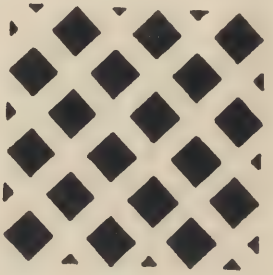

Fig. 19.

little concave (like fig. 17) the effect is surprising. Squares are formed, which in accordance with the position of the stop have a definite situation to each other. If the diameter of the stop is parallel to the lines of the screen the dots turn their corners towards each other (fig. 18). But if the diameter of the stop cuts the lines of the screen at an angle of 45 degrees, then the squares in the negative lie as in fig. 19. Similar, but somewhat more charac-

teristic, is the effect of using the cross-shaped stop (fig. 20). One can in this manner devise numerous variations, but most of them are only interesting as amusement, and without practical value. For instance one can obtain with a double slit stop, a negative with double the number of lines possessed by the screen. Only two shapes of stops of this nature offer any advantage, viz., the single and crossed slit stop. If we choose an oblong shape with the sides parallel to the lines of the screen, oval shaped dots in the direction of the stop are the result (fig. 21), and these with a sufficiently long exposure join and form wavy lines. If the stop is altered in such a way that the slit decreases in the centre, as fig. 22 shows, the result will be equivalent to a single lined screen with sharp straight lines as fig. 23. If two of these slits are crossed at right angles as fig. 24, and exposed under the same conditions of parallelism with the lines of the screen, the result will be the highly interesting and remarkable fact that we obtain from a positive screen a positive image, and by correct experimental conditions the result will be black straight lines as fig. 25. If intensified and, when dry, covered with a protecting glass,

Fig. 20.

the plate can be used as a working screen.

The question is, which is the best stop for half-tone reproduction. Such a stop should modify the dots in the lights in such a manner as to bring about a spreading and intimate joining

Fig. 21.

Fig. 22.

Fig. 23.

together at their four corners. This is obtained by the pointed square or the cross-shaped stop. In the shadows we have to direct our efforts to concentrating the rays on the smallest possible surface. This is obtained by the round stop. A stop which is between these two forms will do the

best service. Of the numerous possible stops those having about the shape of figs. 17 and 26 will answer best for the purpose. But we have to be careful to give the right position, diagonally parallel to the sides of the screen, or we shall obtain the opposite effect to what we desired, as fig. 19 shows very instructively. If one is accustomed to work with two stops it is of advantage to use for the

Fig. 24.

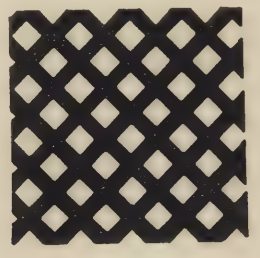

Fig. 25.

shadows the round stop, and for the lights a more pointed one than illustrated in either figs. 26 or 17. By this it is not meant that the round stop is entirely to be rejected. For years we have worked with it, and still use it, and we can yet accomplish good work with it.

Influence of the Light, the Duration of Exposure, and the Development.—The light is so changeable that it is seldom or never possible

in process studios to regulate it, and this is the greatest difficulty to overcome. But there are ways of meeting all inconveniences, and we must take the light as we find it, with all its tricks and caprices. If there is no electric light available it will be best not to take a hard red-toned photograph on a dull winter's day, or the result will be pitiful. If we are, nevertheless, compelled to work under such circumstances, we must in this case choose the shortest possible distance for the screen, and prolong the exposure even to one hour. But it will never be possible to obtain a really good result. Strong diffused light or soft sunlight gives the best results, a strong illumination being requisite. Only wash drawings or grey photographs are best suited for subdued light, the colour in which they are executed being more actinic than the red-brown of albumen prints. The darker the shadows, the more light is wanted to clear them up. If the light is decreased beyond a certain limit, the action in the shadows stops altogether, and even by very long exposure no light impression is obtained. Accordingly subdued light gives more contrast than strong, and generally small

Fig. 26.

stops are necessary to bring about the result, whilst with strong light larger stops can be used.

A further important influence on the modulation of the dots is the duration of the exposure. It is well known in ordinary photographic work that prolonged exposures give soft negatives, and over-exposure gives feeble negatives. The same, as well as the opposite fact that short exposures give hard negatives, prevails, within certain limits, in the half-tone process. But we must keep in mind that other matters come into play (such as the stop and distance) and that a half-tone negative is never ready for use after developing and fixing; it has to go through a series of further operations before it is finished, and this changes the appearance of the developed picture. It does not follow that hardness is in all cases due to under-exposure, because it may be that the action of the light in the lighter tones has been counteracted by the use of a small stop or short distance of the screen. The light thus acted more towards the production of density than in causing the spreading of the dots. A prolonged exposure may absolutely give more contrast; for instance, if the development is interrupted at the right time and a strong intensification given. In disregard of such cases, every negative should be slightly over-exposed and fully developed. The reason for this is described later on in the chapter relating to the

after-treatment in the negative. Strongly exposed and under-developed negatives show great imperfection. There is a lack of strength and density in the dots, because the whole of the silver acted upon by light has not been reduced owing to the shortness of the development. The dots in the shadows instead of being small, sharp, and dense, are thin, scattered patches, with which nothing can be done. The same want of sharpness prevails in the lights, where the joining of the dots into lines is lacking.

I have described at some length the principles which are the basis of the work with the screen, because I believe that with this knowledge a quicker understanding of appearances which come into evidence in the practical working of the half-tone process will be attained, so that the operator can meet all exigencies. The manipulations of negative making I presume to be well known, and I shall only describe those operations which apply to work where the screen is used, together with any new matters appertaining to the subject.

The Practice of Half-tone Operating.—The photographer who undertakes to make a half-tone negative must first examine his subject as to its colour, strength, and detail, and take into consideration the size of the reproduction, because by reduction of size the relative clearness of the picture

increases. From these facts, as well as upon the conditions of the light, the character of negative desired, and above all the distance of the screen, he has to determine the diameter of the stop, and the approximate duration of the exposure. After this he fastens up the original on the copyboard in such a manner that it is central to the axis of the lens, so as to avoid inequalities of surface, uneven lighting and reflections, etc., and focusses sharply. On the last point greater care has to be taken than with line originals. Any carelessness in this respect gives trouble afterwards, and want of sharpness is capable of making even the best of negatives valueless.

Much care has to be bestowed on the cleaning and polishing of the screen. Even though it may seem trivial such matters must be learnt and understood. It may happen that drops of silver solution come on the surface, and these must be removed with blotting paper. The polishing is done in the same way as with negative glass, with mixtures of alcohol, ammonia, and Vienna chalk, or whiting, using clean and soft pads of Joseph paper. The final polishing is given with a soft leather, and the dust which the glass attracts (being electric through the rubbing) is removed with a soft brush. It is not out of place to observe that a grain of sand or grit may entirely spoil the screen; therefore all materials for cleaning must

be carefully preserved free from impurities. After cleaning, the screen is fixed in the dark slide, and covered with a preserving glass, which is only removed when the sensitive plate is inserted for exposure, and replaced afterwards. Anyone who takes this precaution saves the screen very much, as it has not to be so often cleaned; it may even go whole days without being taken out.

The distance of the screen from the sensitive plate is subject to the number of lines to the inch and to the focus of the lens. For a screen of 150 lines it will be about $\frac{3}{16}$ths of an inch, measured from the cementing of the screen. This makes about $\frac{1}{16}$th to $\frac{3}{32}$nds of an inch between the surfaces, and this separation may be made with three strips of blotting board. For shortening the exposure, or because larger stops are used, we can place the screen a little closer to the sensitive plate.

Fig. 27.

Polished plate glass is necessary for the negative making. On account of the numerous washings which the collodion film has to undergo under a strong rose tap (fig. 27) to save time, the glasses are, after cleaning, coated with albumen. The

white of an egg is well beaten in about two quarts of water. This is poured twice over the plate whilst wet, and is then dried. This substratum makes the collodion film very resistant without hindering the subsequent process of stripping the film. Those who prefer to use polished plates without substratum must not forget to border them.

A full exposure with a medium stop, about *f*/16 or *f*/22 is given, and the plate developed. We have now to determine whether the exposure on the one hand, or the choice of the stop on the other, was correct. The first is determined, if after developing the plate, without considering the lights, a small dot has commenced to form in the shadows. But the correctness of the stop is known, if in disregard of under-exposure of the shadows, the high-lights in comparison with the shadows, possess the necessary contrast. By over-exposure the shadows are too clear, and the lights are too intense; whilst by under-exposure the shadows are too transparent, but at the same time the high-light dots are not sufficiently closed. By experience it can soon be seen for certain whether a negative is serviceable, after developing and fixing (in a weak solution of cyanide of potassium), and with this knowledge a great deal of trouble is saved. From an original of medium strength, the dense dot in the high-lights must

have the relative size of the dots in fig. 28, without the dots being joined up and blended into each other in the highest lights, and the general appearance of all the dots will be wanting in sharpness. Of possible intensifiers those only are of advantage which build up most powerfully, such as lead; mercury is less satisfactory; and the best is the copper intensifier with the subsequent blackening with silver, this intensifier being almost without exception in use. Equal parts of 12 per cent. sulphate of copper solution, and 6 per cent. bromide of potassium solution are mixed together, and with this the negative is flowed over from wide-mouthed bottles or immersed in a dish. After very careful washing under a rose tap the plate is flowed or bathed with a dilute solution of nitrate of silver, about 5 per cent. The chief advantage of this intensifier is the possibility of repeating it several times on the same negative. If after the first intensification the necessary strength and density is not obtained, the operations can be repeated a second, third, and even a fourth time. Thorough washing must not be omitted, or a yellow veil will be left after the further blackening with sulphide of

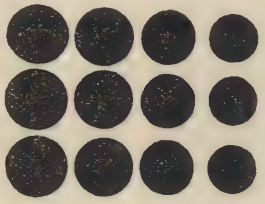

Fig. 28.

ammonia. In case of a slight veil a clearing bath of dilute hydrochloric acid is a remedy, and this should generally be used after blackening with sulphide of ammonium. If the yellow veil is considerable a concentrated solution of cyanide of potassium may be tried, but this must be done carefully, as the density of the dots is also attacked by it. Even if the choice of stop or exposure be correct it is very seldom that a half-tone negative is serviceable after one intensification. In no case is the best quality of the negative obtained at the first attempt. If we examine the shape of the dots with a magnifying glass (one of three-fold power is the best) we see that they have after the first intensifying attained such a size that they overlap one another, with moderately sharp edges, but when using the round stop the density at the points where the dots join is insufficient, and the shape of the transparent openings is advantageous, being star-pointed. Further the shadow dots are seldom brought out well after one intensification; they lack the necessary density and sharpness. Therefore, in such cases, we use the intensifier a second time, and compare the result. The entire closing up of the lights will now be attained and the transparent openings will have changed into a more square shape with blunt edges, whilst the dots in the shadows appear sharper and denser. The enlarged negative illustrated in Supplement VI. may

be turned to for an example of the right appearance.

But even in these ways the best negative may not be attained, it being difficult for the operator to choose every time, not only the correct stop, but to guess also accurately the duration of the exposure so that the dots in the shadows possess the necessary fineness. I had occasion to recommend previously that as a rule a little over-exposure was advantageous. In such cases we intensify once as ordinarily with copper and silver, and after washing well, pour over the negative a solution of wine-yellow or wine-red iodine in water dissolved by the addition of any iodide salt, for instance, iodide of potassium (iodine dissolving alone in water only in the proportion of 1·6000) until the silver on the surface of the negative is converted into iodide of silver. It is useless, and needless, to pursue the conversion until the whole picture is formed into iodide of silver. As soon as there appears a green sheen in the shadows, the treatment with iodine is interrupted, the plate washed superficially, and a very dilute solution of cyanide of potassium is poured over in one even flow. According to the strength of the solution a quicker or slower dissolving out of the iodide of silver takes place, and it is easy to follow this by holding the negative against a dark object, for instance the bottom of the washing tank. Instead of using iodine and

cyanide of potassium separately they can be mixed beforehand, or instead of this a solution of ferrid-cyanide of potassium and hypo may be used. The ground of the negative becomes clear glass, the dots sharpen, whilst all the granular deposit attacked by the iodide varnishes, and in the shadows a very sharp and small round dot is formed. If thereby the lights, as is generally the case, have cleared up too much, or the dots in the shadows have lost in density, then the negative should be re-intensified until the desired effect is attained, and in this way will be obtained a perfect negative. If the exposure was too much prolonged, and consequently the shadows are filled up with a thick black deposit, the reduction with iodide and cyanide of potassium is difficult, because the solutions have to be used strong, so that with the reduction of size a reduction of density goes hand in hand, the dots becoming transparent to such a degree that the subsequent intensification does not repair the damage. In this case it is better to intensify and reduce alternately, whereby a gradual increase of contrast takes place. Over-exposure is easily recognisable by the time the picture takes to make its appearance in development. I have nothing new to add to my earlier explanation on the shape and density of the dots. If the over-exposure is very great we ultimately get a result in which the dissecting influence of the screen

altogether disappears and it gives the impression of a negative produced without it. Under some circumstances it is undoubtedly advisable to somewhat over-expose with a shorter development, so as to force contrast in feeble originals. In this manner the shadows are kept back, and can be vigorously intensified without the necessity of weakening the high-lights with strong reducers of iodine and cyanide of potassium. If the stop chosen has been unsuitable, *i.e.*, if the negative taken with it does not show the desired modulation, then the exposure must be made with a larger or smaller stop, either for the full time, or by changing for a fraction of the time. The desirability of a further exposure is best determined by comparing the last finished negative with the first one. As we have already explained large stops give the lights and small stops the shadows. By strict observance of this rule, and by considering that the duration of exposure increases inversely as the square of the relative diameter of the stop, we shall, supposing the distance chosen at the outset was not too great, arrive at the desired result. It is quite sufficient to work with the stops only. The changing of the distance is circumstantial and is for several reasons risky, so that we need only decide to resort to it as a last extremity. In making exposures with changed stops two sizes from the customary set of diaphragms should be chosen, with not too sudden

a jump between their relative proportions, or the different exposures will be exaggerated, and with these successive exposures are made for a proportionate time, that is to say, the exposure with the larger stop must not be too short, or it will not give enough strength, according to its value, and the result in the finished negative will be recognised by a zone of weaker density (fig. 29).

If it is necessary to take a hard original in a bad light it is advisable, according to what I have already said, to use a very small stop in order to keep back the high-lights as much as possible. It occurs sometimes that owing to over-exposure the clear parts of the negative are slightly veiled through diffused light, and when we come to intensify, the high-lights close up to a nearly uniform blackness. It is impossible to reduce strongly without weakening the feeble detail in the shadows. In such case a dodge which renders good service may be resorted to, viz., exposing for a fraction of the time on a clean white sheet of paper covering the original. The result is that the negative is covered evenly with fine dots. Naturally in this manner the shadows are a little lightened,

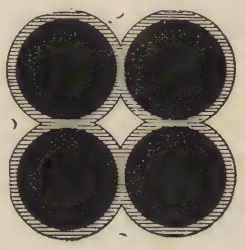

Fig. 29.

but are not better detailed. The original must, therefore, be exposed until the detail is at least indicated by feeble dots. The exposure on the paper is then resorted to, to strengthen the latter. Glaring lights can be smoothed down in a similar way whilst exposing, by moving about a piece of black velvet fastened to a blackened wire. It often occurs that large spaces, such as skies, on the original are not clean and uniform or have too much tone. If the contour of the landscape is rather simple a pattern of white paper may be cut out, and held with a little movement (to prevent sharp borders) over the space on the original which has to be cleared up, exposing for a short time.

In the winter time, the veiling of the screen with dampness is very vexatious. This occurs in studios which are warmer than the dark-room. If the latter is not warmed the only expedient will be to warm the screen. The action of the damp veil is easily distinguished on the negative by the raggedness and unevenness of the dots.

A beginner will often find in the course of his work that phenomena make their appearance for which he cannot for the moment account nor prevent. He should, as I have done, keep a diary, and note in it carefully for every negative the circumstances under which it was taken, the character of the original, the light prevailing, the duration of exposure, the size of stops used, the speed with

which the picture developed, the nature and size of dots before and after intensifying and reducing, and the final result. This may seem circumstantial, but I am assured from my own experience of this method of work that it leads the beginner to a knowledge of such phenomena, and how to secure a successful result. One must not rely on memory, the best forsakes one sometimes. If we have a long series of notes at hand then a systematic comparison will give the reason for any difficulties. Though the half-tone process is entirely a mechanical one it is notwithstanding necessary to avoid working like a machine, especially in the photographic part. What else can be the cause of such a large percentage of bad half-tone photographers? A boy is apprenticed to a photographer, and sees the manipulation of the process, which he learns, without thinking very deeply about it, and without bothering his head much over the why and wherefore of it. When he is advanced later on to an independent position as operator he knows nothing more than he has seen. If the conditions and exterior circumstances under which he works are the same, and the manner of working which he has learnt a good one, he will turn out a good photographer. But if it happens that some trifling difficulty, ridiculous in itself, yet quite new to him, comes in his way, then his whole process is thrown out of gear, because he has not

learned to think. He will seek in the silver bath for the cause of streaks when actually the screen was not cleanly polished, or complain that the lens is not strong enough when the real cause is that the screen distance was much too great. However highly we may estimate the practice, the theory is nevertheless the animating spirit of it.

In the following I give a comprehensive summary of the usual faults presented :—

Dots sharp and dense, but too large in the shadows, the high-lights not closed : over-exposure and too small a stop (for the distance).

Dots sharp and dense, shadows correct, but the high-lights not joined : exposure all right, but too small a stop (for the distance).

Dots sharp and dense, too large in the shadows, lights closed too much : stop correct but over-exposed.

Shadows too transparent, with very feeble, and partly lost dots, lights not closed : stop correct but time of exposure too short.

Dots in the lights too square, lacking sharpness, and without good joining, dots in the shadows very grey and too much spread out : over-exposure and under-development.

Dots in the high-lights too much closed, shadows transparent : exposed with too large a stop (for the distance).

Dots very indefinite, and hardly recognisable, feeble in density, grey: very much over-exposed (with large stop or too great a distance).

The transparent spaces in the high-lights veiled: due to long exposure (generally in bad light) or too large a stop.

No contrast, in spite of using large stop, particularly in bad light; too great a distance, for instance, with lenses of long focus.

No contrast, in spite of using small stop, especially in good light: too much distance, *i.e.*, for lenses with short focus, or owing to strong reduction.

Circular streaks: screen not cleanly polished.

Negative with uneven contrast: original not evenly lighted, or screen not parallel to sensitive plate.

Dots ragged and shapeless, looking like a grained negative: screen veiled with dampness (usually occurs in the winter).

CHAPTER III.

STRIPPING AND REVERSING THE NEGATIVE.

In America only the direct printing process on metal is used. The result of this is that reversed negatives are required. Prisms are for various reasons not popular there. Apart from their great cost it would necessitate an entirely different arrangement of the copying stands and putting the comfortable and cheap swinging camera base out of use. A further reason is the rather considerable increase of exposure, and the fact that it is impossible to combine a number of negatives on one plate for printing and etching. How would it be possible, with the low prices now obtained, for a process establishment to exist without obtaining a number of prints on one plate? Of course the combination of large plates can only be used to a limited extent, because of the difficulty of the half-tone process, but after all there is not sufficient reason for giving up the old plan of taking the negatives direct and reversing them by means of a

very short process. In large establishments a boy is employed for this work, otherwise the photographer, printer, retoucher, or some one else finds time in spare moments—the operator for instance during an exposure—to do this little duty.

If the work is hurried, hardly more than a few minutes is required for reversing. For quickly drying of the negative either the direct flame of a bunsen burner is used or the negatives are placed in a drying box; they may also be dried by being leaned against a steam tube or by applying heat under the plate rack, by means of a tube provided with small bunsen burners. When the negative is dry and cool it is coated with indiarubber solution. The way of making this is to dissolve commercial indiarubber cement in benzole until entirely liquid, and after coating and drying it forms a very thin film which can be rubbed away with the finger. Solid indiarubber, which must not be vulcanised, should be dissolved by soaking it first in chloroform and allowing it to stand until it swells a good deal and forms a thick syrupy mass. This is diluted for use with benzole, the solution being shaken well until all is dissolved, and then filtered through cotton wool. The solution will filter quickly enough if no more solid portions are present. The benzole evaporates from the film on the negative in a short time, and may be hastened by holding the plate over a flame for a few moments. When cool it is coated with

leather-collodion, *i.e.*, two per cent. plain collodion with a little castor oil added. An excess of alcohol in the collodion is of advantage by increasing the flexibility of the film. The addition of oil must not be carried too far, as the pyroxylin being only two per cent. strength the film will be too much softened and will cause a flattening out in the printing frame. Too little oil, on the other hand, makes the film hard and wrinkled and prevents strong adherence to the glass. The following recipe has been well tried:—

Alcohol		65 parts.
Ether		35 ,,
Pyroxylin		2 ,,
Castor oil	1 to	1½ ,,

In order to secure even thickness of the film, and because where there is no indiarubber covering, the negative film is dissolved by the collodion, and the picture soiled by the silver running over, it is better after the second coating to pour off from the opposite corner. To ensure the easy stripping of the film it must be perfectly dry before each coating. Never pour the solution on to the warm negative, or air bubbles will be the result, rendering the negative under some circumstances, useless. If the leather collodion tears up raggedly it is too thick and must be diluted with equal parts of ether and alcohol. If thicker films are preferred leather collodion can be poured on a second time. When

this film is dry (to hasten drying heat can be applied), a cut is made in the margin of the picture and the plate immersed in water to which has been added acetic or sulphuric acid. According to the strength of albumen solution with which the negative has been coated at the outset, the film loosens either immediately or after a short time so that it is possible to take it with the fingers and lift it off. It is then turned and laid on a wetted piece of plate glass. This operation is with a little practice and care, quite certain without any danger, and even with the largest sizes the loss of a negative except through carelessness is impossible. The film is then squeegeed to the glass with a very light rubber squeegee of the thickness of a cardboard, or with strips of copper-plate printing paper, scraping from the centre to the edges of the glass, any remaining drops of water being removed with blotting paper. If contrary to expectation a loosening at the edges occurs it is sufficient to apply a touch of gum solution to them. When the film is at last dry by warming for a few moments, the process of reversing is accomplished. If, as is generally the case, a fine line round the picture is desired, a cut can be made in the desired place before stripping the negative. The margin will print solid black and the engraver can cut the thickness of the line as desired. It is more certain if the negative after stripping (for which operation it is of advantage to

leave a margin to take hold of the film by) is cut sharply along the limits of the picture, and the useless strips removed by damping them slightly. A third way is to make the margin line with a pointed piece of wood, on the dry uncoated negative, in such a manner that only the superficial deposit on the film is removed, without injuring the supporting collodion.

The collodion films offer a further advantage which is worth noting. It often happens that half-tones are wanted with borders of line work. Nothing is easier than cutting the two negatives so as to fit the half-tone into the line negative, when both may be etched together. A particularly experienced hand is necessary to combine etched plates in this manner, and even when great care is exercised, to obtain the exact type height of all parts it requires increased attention on the part of the printer to equalize by means of overlays the unavoidable defects.

The Direct Printing of Negative Films on the Metal.—In conjunction with the stripping and turning of the negatives, I shall speak directly on how to print negatives on the metal without a frame. This method, especially for line negatives, in certain cases has great advantages and is also applicable for half tones. If for instance, an original has to be reproduced of a size exceeding the capacity of the lens and printing frame, it had

formerly to be photographed, printed, and etched in several parts; but the following method will be found better, and will lead to a direct result whilst avoiding double work. For coating the different parts to be combined, more concentrated solutions of indiarubber and collodion are used or, after the drying, the plate is coated a second time and allowed to dry in a horizontal position so as to obtain thicker and more resisting films. The negatives are cut to match, and stripped; and can then (the coated side upwards) be laid together on a glass plate. Another coating with indiarubber and collodion is given and the whole stripped as an ordinary negative. The single pieces may, however, be joined together and used at once without stripping for printing on the metal. It is a condition of success that the films should be perfectly dry. The best way is to put them between layers of blotting-paper and dry with heat. Meanwhile a zinc plate has been prepared with albumen or enamel solution as described in the following chapter. If the plate is dry it may be flowed over with spirit of turpentine free from water, and the negative films, also dipped into the turpentine, are then laid on the plate and squeegeed with a flat, light, felt squeegee. After exposure the plate is brought again into the printing-room and the films taken off. When the turpentine has evaporated over a stove, the further manipulations

are taken in hand in the manner described later on. Instead of turpentine some use castor oil, a few drops of which is distributed with a little gelatine roller. Paraffin is also used as a cement. In any case no trace of water must come in contact with the prepared plate—even atmospheric dampness may harm it; the films will not come off and are irreparably lost. If printed on asphalt the process is much simplified because the films are put down wet as they come from the glass and can be taken off under water.

CHAPTER IV.

THE PRINTING PROCESS.

When the negative is finished, reversed, and dried, as described in the preceding chapters, it comes into the hands of the printer. The latter has to make on a flat metal plate a print from it adapted to resist the acid solution, by deepening the bare parts of the metal. For this purpose a planed zinc, copper, or brass plate is coated with a solution of albumen and chromate salt, exposed to light under the negative, coated with a fatty ink, and the parts not acted upon by the light, washed away with water. We then secure from a negative a positive on metal, which after deepening of the uncovered parts serves as a printing surface for the press. The metal may be coated with other substances, made sensitive to light, such as gum arabic, fish glue, or thicker solutions of albumen, and developed without rolling up, with fatty ink. Printing with asphalt is mostly out of use, as is also the transfer printing process. Both require too

much time or a too complicated apparatus. All processes for letterpress reproductions must possess simplicity and speed. A process may give better results, but as soon as it exceeds the shortest time attained by other processes it is abandoned, because time is money. It is for this reason that the ingenious swelling process has been entirely discarded, and the gelatine wash-out process is on its death-bed, whilst the carbon process offers no new advantages in practice. Of all methods, business has adopted the direct printing albumen process as the shortest, the cheapest, and the easiest to handle. It needs hardly any arrangements worthy of the name, and its results are amongst the best, though undoubtedly surpassed for beauty in the half-tone process by the direct printing enamel preparations.

The Zinc.—Of the materials coming under consideration, zinc and its handling deserves first attention. If the zinc is bought in raw rolled sheets, the plate polisher, employed in every large firm, chooses first the best side of the zinc by etching a corner of both sides in a weak (about five per cent.) nitric acid solution; the zinc is liquid at the commencement of rolling it into sheets, it bubbles, and particles of grit mount to the surface. Thus every sheet has two different surfaces of which the better one is easily ascertained by applying the etching brush. After etching, pure

zinc should have a silvery lustre. A slight percentage of lead is of no consequence, but an excess causes the plate to become rough and to etch unevenly, because the nitric acid dissolves the lead much more slowly than the zinc. The presence of lead is to be distinguished by its brilliancy and the colour of the metal. For the same reason carbon, next to lead, disturbs the uniformity of the etching. If little cracks and holes are present, and the metal blisters in different places, or shows a streaky structure, there has been some fault in rolling the sheets, and this makes the metal unfit for etching purposes. The acid finds its way through the porous surface, and undercuts the fine dots and lines. In general, Belgian zinc is regarded as the best. It is possible that an inferior quality is exported to America, or the etchers there do not understand the advantages of it. In short it is not much liked, because of its slow etching and its dark colour. The superiority is left to the native product. The grinding and polishing of the zinc plates is troublesome work, especially if the latter are intended for half-tone purposes. The best plan is to etch the plates first with a diluted nitric acid solution, until they are cleaned of oxide, and then to grind them down wet with a piece of finest pumice stone in the direction in which they have been rolled into sheets. If large depressions are present which cannot be levelled by grinding, mark them with a marking

gauge, punch them out and grind again. Small but deep holes or cracks which cannot be punched out are covered with shellac or asphalt varnish, and by further etching the plate elevations are created

Fig. 30.

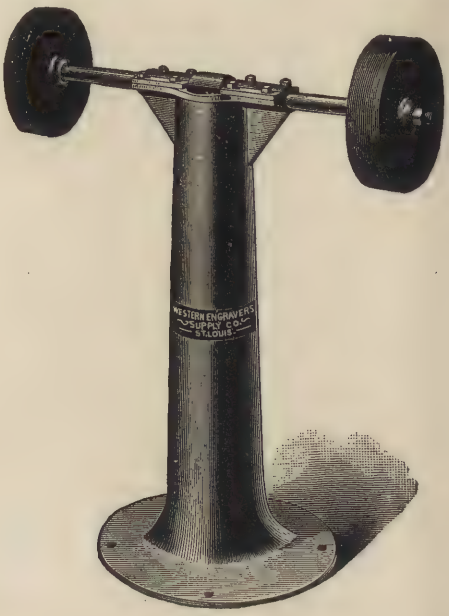

Fig. 31.

round the holes, so that the latter can be removed by treating the plate again with the stone. The stone polished plates are still too rough for etching purposes, and to remove this, rotten-stone, and afterwards charcoal or emery powder of increasing

fineness, is used. It is to be remembered that the polishing must be done always in the same direction. Instead of etching the plates a scraper (fig. 30) can be used, but the handling of this tool requires practice and skill. All comparatively large establishments in New York run a polishing machine,

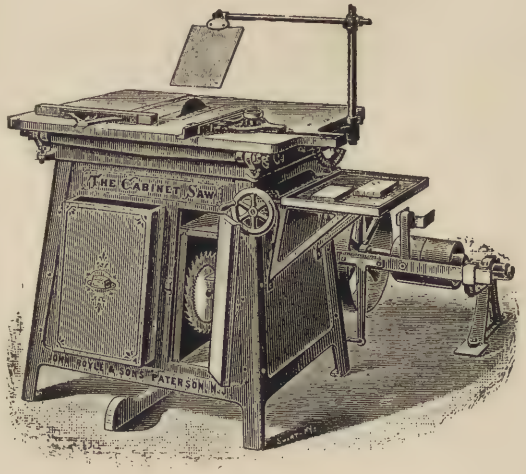

Fig. 32.

which executes the polishing work far better and more quickly. This machine is in principle a very quick rotating axle, on the ends of which are two discs composed of circular pieces of linen or flannel screwed together in the middle (see fig. 31). Through the centrifugal force the separate layers stretch out and form a complete, hard but elastic

wheel which with the assistance of a polishing medium composed of tallow and emery powder or English rouge, polishes admirably. Instead of linen or flannel, rhinoceros leather pads are used with advantage. The cutting up of the plates to the desired sizes is done with the zinc cutter, which is a piece of steel bent into an angle, or with a circular saw (fig. 32). When the burr of the edges has been filed down the plate is delivered to the printing-room where it receives the last operations before printing.

These consist of freeing the zinc from any greasiness by washing it with a solution of soda or potash, or by mechanical rubbing with a tuft of damp cotton wool dipped in the finest emery powder until the water is not repelled by the plate. Many workers hold that a highly polished plate is undesirable, preferring a matted one. For this purpose a solution of nitric acid and alum is poured over the plate, or it is put into a bath of this solution, and left to its action for a short time until the polished surface has taken an evenly dull matt. In this state the plate is ready to be coated with a sensitive solution. If this is not done directly, care must be taken that the plate is quickly dried or kept under water. Copper is also treated in the same manner as zinc. Because of its hardness and the difficulty in working it, it is generally bought highly polished or at least evenly ground down.

Materials for Printing.—For the plant in the printing process in the first instance, a whirler is necessary. This is for the purpose of dis-

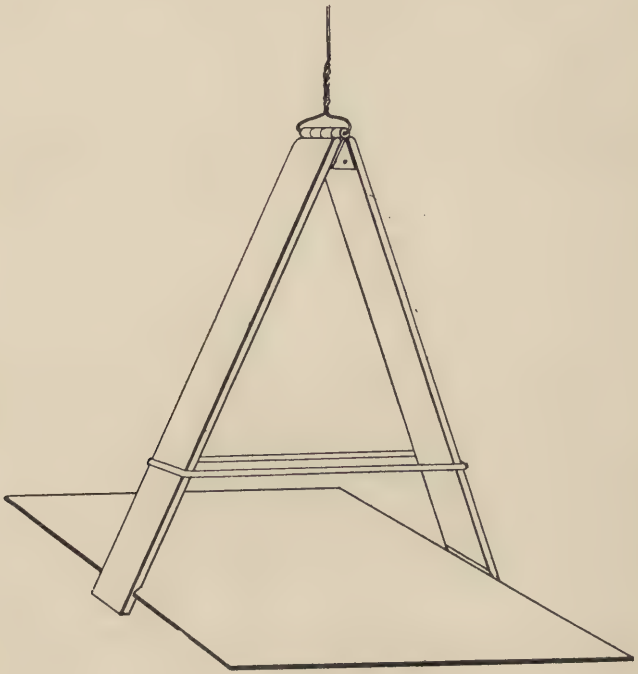

Fig. 33.

tributing the solution evenly on the plate, and for removing the excess. The most simple construction consists of two small flat wooden legs of about 16 to 28 inches long, which are connected at one

end with a hinge or strip of leather. Near to the other end on the inside are cut two notches, in which the plate rests, clamped between the two legs. An indiarubber band round the legs holds the plate whilst in rotation. The whole arrangement hangs on a short piece of string or wire, and

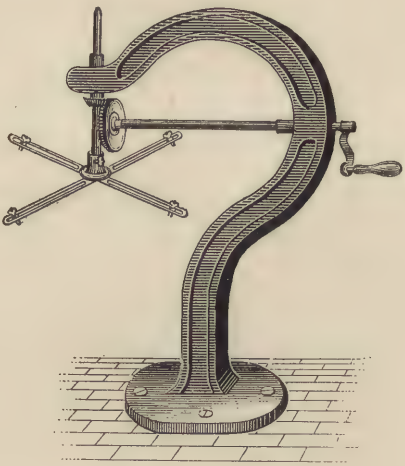

Fig. 34.

by turning the latter it can be set into the quick rotation desired (fig. 33). Simple and unpretending as this construction is, it renders good service. It is certainly a little awkward to work with; nevertheless, printers who have used it prefer it to many other more elaborate kinds, as it gives the

cleanest and most even films. In other constructions the turning movement is operated by means of a handle or cog wheel. They are built partly of wood and partly of iron, and are more or less practical. To prevent splashing of the solution, and also to keep the dust out, the disc or cross is surrounded by a flat case with cover. The disc is provided with numerous holes, in which four short pieces of wood are fixed, between which the

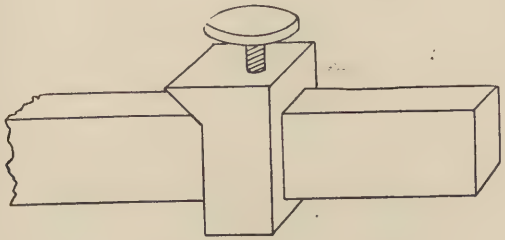

Fig. 35.

rotating plate is fastened, or the latter is fixed as in illustration (fig. 34), between two or four moveable screws. The clumsy wooden disc can be omitted, and an iron cross can be put in its place. The kind illustrated by fig. 34, in the form of an interrogation mark, is especially to be recommended. The axle with the cross can be taken off. The plate is fastened with the four screws, then prepared and whirled film downward to avoid the dust. At the same time the plate can

be dried by means of a gas burner placed under it. In the same manner as with the film downward, the plate can be whirled film upwards by fixing the axle from the top. By this means the unmounting of the cross after every coating is avoided, whilst the case with a cover prevents the entrance of the dust. I have replaced the cross with its flat divided arms, by solid square iron rods, and con-

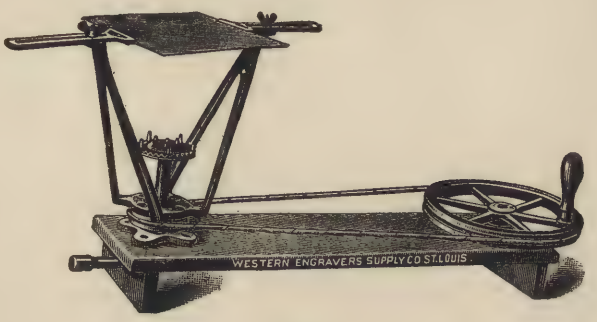

Fig. 36.

structed the catches with turned up edges in such a manner that they are able to keep the plates down (fig. 35). The whole machine stands under a table, and is fastened with screws to a strong board. The cross only rises over the table, and is protected against dust by a flat case, which can be opened entirely or only partly in the middle. The drying of the plate is done in this case over gas or on a hot stone, which receives its heat from a gas

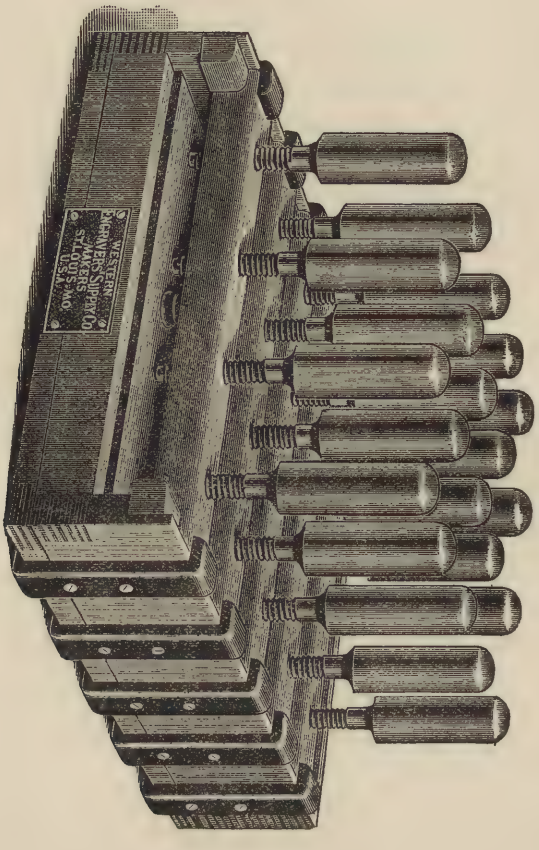

Fig. 37.

G

stove or steam tube. A further arrangement for whirling and drying at the same time, is shown in fig. 36. All these constructions are good so long as they fulfil their purpose, which is to distribute evenly the solution which has been poured on a flat surface.

Besides the whirler with the necessary arrangement for drying, the printing-room requires a water sink for washing the plates, and a flat tray for developing. This may be a wooden tray, zinc lined, provided with cover and tap, a couple of ink rollers and ink slab (a fixed plate of glass) and a number of printing frames, the size of which are in comparison to the size of the combined negatives, and is in general not smaller than 11×14 inches, and not larger than 18×22 inches, the plate glass being not able to support the weight of the screws and wedges in larger sizes. The old kind of printing frame is sufficiently known to be omitted here; instead of wedges wooden screws were used, which to the number of 9 to 12 for 11×14, or 16 to 20 for 14×17 frames, allowed a better distribution of the pressure (see illustrations, figs. 37, 38, and 39). To avoid the handling of so many screws the number of these has been reduced to two or one, and the others compensated for by a construction which is very similar to a copying press. The back has been constructed from a flat iron plate with sufficient resistance to distribute the pressure

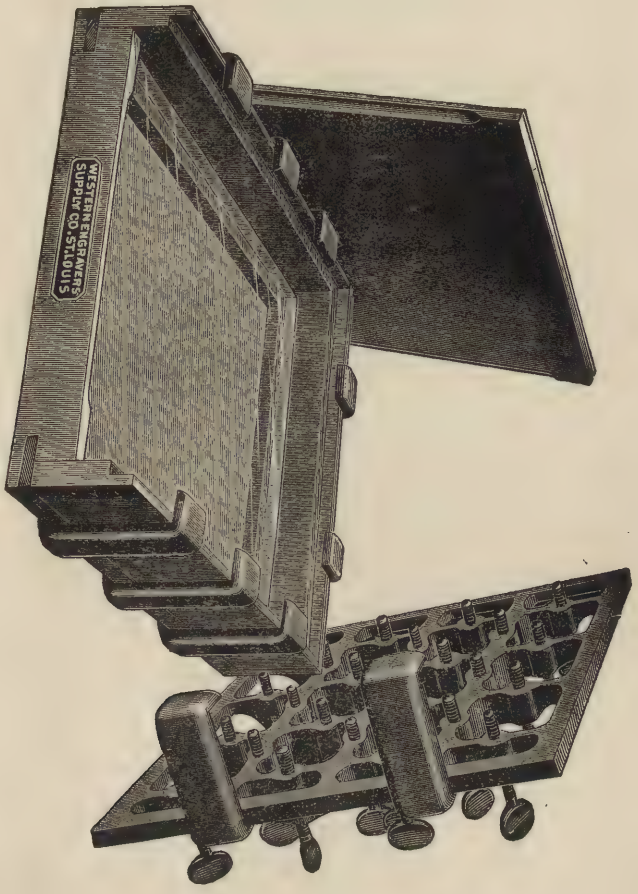

Fig 38.

of one or two screws over the whole surface. The pressure of wedges is entirely sufficient to press zinc plates of ordinary thickness perfectly against the negative. It is more difficult to obtain sufficient contact with copper plates, and therefore the massive screw frames have been introduced. In proportion to the high pressure the thickness of

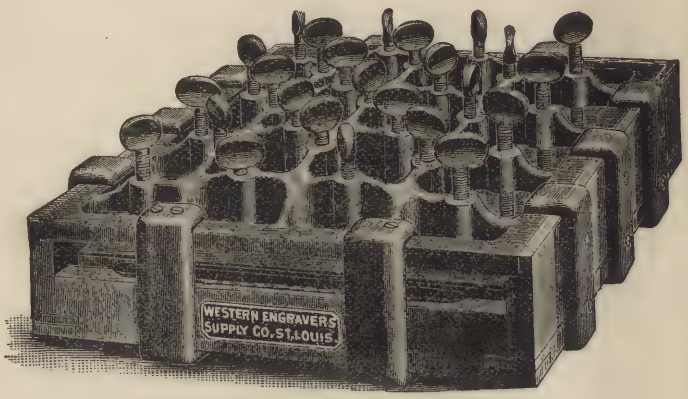

Fig. 39.

the printing frame glasses has been increased, and plates three-quarters to one inch thickness are generally used. Figs. 40 and 41 show a frame with two screws. After exposure of the sensitive plate it is covered with a thin film of greasy ink—*i.e.*, transfer ink, or a special preparation is used for this purpose. The ink must be easy to distribute and sufficiently greasy to develop with

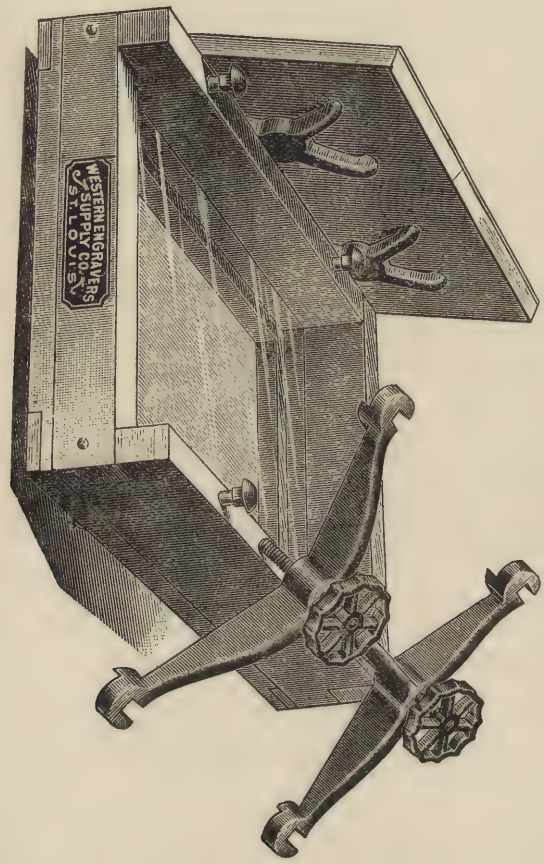

Fig. 40.

sharp edges and without smearing. For many years I have made my rolling-up ink myself,

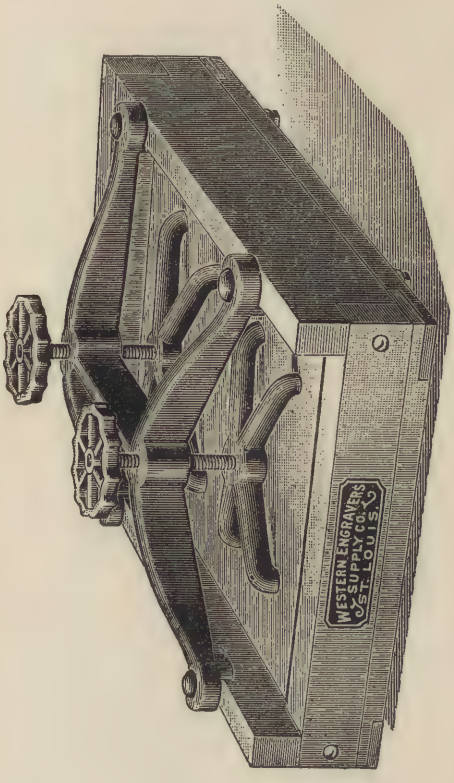

Fig 41.

according to the following recipe, and have the pleasure of knowing that both printers and etchers are very well satisfied with this for its easily

developing properties and acid-resisting qualities:—

Asphalt	1 part.
Resin	1 ,,
Wax	1 ,,
Mutton tallow	1 ,,
Letterpress ink	9 parts.
Venice Turpentine	1 to 1½ ,,

These are dissolved in the order given, and thinned with turpentine to the consistence of soft soap. Two very soft leather or compo rollers serve for the even distribution of the ink. Besides the greasy ink, solutions of asphalt may be used instead for coating the printed plates, but, so far as I know, they are not much in vogue.

The preparation of the albumen solution is very simple, and consists of white of egg, chromate salt and water, with or without the addition of ammonium or alcohol. The white of a fresh egg is beaten to froth, diluted with 7 to 8 ozs. water, with about 15 grains bichromate of ammonia powdered in a mortar and added; the whole is filtered through cotton wool once or more until entirely clear, avoiding the formation of air bubbles. Instead of ammonium bichromate, 1 oz. of a saturated solution of potassium bichromate may be used. A few drops of liquor ammonia makes the solution keep better. By increasing the amount of the chromate salt, and also by diluting with water, the sensitiveness of the film increases so much that after a few seconds exposure in sun-

light a picture is obtained ready for development. But nothing is to be gained by such extremely sensitive preparations, except in case of bad light, as very dense negatives are required. The chance of the success of the print, on account of the probability of easily over or under-exposing, are much less, and besides this the excessive thinness of the film renders the development more difficult. An excess of the chromate salt makes the film porous. The solutions will keep for a certain time; according to an experiment I have made, an albumen solution of my own make, six months old, gave a print which on development was not to be distinguished from a fresh one. The solution is made in the following manner: white of egg is beaten to a froth and allowed to stand until clear. Meanwhile, a larger quantity of the following solution is made:—

Liquor ammonia	12 parts.
Alcohol	18 ,,
Ammonium bichromate	6 ,,
Water	100 ,,

A part of the albumen solution is mixed with an equal part of the chromate solution, diluted with two parts of water, and filtered through cotton wool. The best way is to tie over the pouring bottle (a tall wide-mouthed one is preferred) a linen or coarse bolting cloth, and to thus obtain whilst pouring a second filtration. As a matter of course,

in this case we have to provide for the necessary circulation of air by introducing a tube in the neck of the bottle. Instead of fresh eggs the commercial egg albumen may be used with equal success. It must be dissolved in the same quantity of water as is contained in the white of egg, viz., 14 parts albumen in 100 parts of water. Possibly the commercial albumen may not be pure, and at any rate its sensitiveness is about half that of fresh white of egg. Taking into consideration this circumstance, the solution should be diluted further, according to the following formula, and thereby the cost of making the solution is very much less.

SOLUTION 1.

Dried albumen	14 parts.
Water	100 ,,

SOLUTION 2.

Alcohol	18 parts.
Ammonium bichromate	6 ,,
Liq. ammonia	12 ,,
Water	100 ,,

The solutions are mixed together, diluted with 400 parts water and filtered. The dissolving of the albumen is assisted by adding liquor ammonia to a reasonable extent. The chromated albumen is not very sensitive to light, and it is not necessary to fear daylight affecting it much, nor is it necessary to be over-careful in making the printing-room into a dark-room. If it should happen that the daylight has an influence on the plates, we can at all

events pour over the window of the printing-room a well filtered and very thin yellow solution of asphalt in turpentine. Any further precautions are superfluous.

To complete the arrangements of the copying room an electric arc lamp is required, so as not to depend entirely on the fitfulness of sunlight. It is not necessary to have a lamp of 16,000 candle power as is used by the Moss Engraving Company, of New York. With one of 4000 candle power, provided with a reflector for the concentration of the rays, we have a source of light which represents for small sized plates, with the frame at a convenient distance, more than half the strength of sunlight.

Coating the Plate with Albumen.—When the solution is ready for use, the zinc plate clean, the whirler freed from dust by means of a damp rag, and the drying stove at the right heat, the coating of the plates can be proceeded with. The plate is well washed under the water tap, drained, laid flat on the left hand, and a sufficient quantity of the solution poured on it a little to the left side. When the opposite left-hand corner is covered, allow the solution to flow to the right-hand side driving the water before it as the excess flows off at the lowest corner into the sink. The plate is inclined back so that the solution flows again to the centre, then fixed on the whirler, and quickly

rotated. The speed is difficult to determine, and is mainly subject to the construction of the whirler, but it should be a rule to whirl always for the same time, and with the same speed. In this way films will be obtained of equal thickness and sensitiveness. Whirling either too quickly or too slowly results in an uneven distribution of the solution. If the plate is not dried on the whirler, it is now taken off and dried over a gas-stove or heating-plate. It is not necessary to be very careful in warming the plate. So long as the metal can be borne on the hand there is no danger that insolubility will occur through coagulation of the albumen. In damp or cold weather it is of advantage to warm the negative to prevent moisture forming between the negative and zinc, which would stick together. The best way of bringing them together is to lay the zinc across a corner of the table, and to place the negative, film downwards, upon it in the desired position. The two are then pressed together with both thumbs and fingers, lifted and turned over quickly. All uncleanliness of the glass side of the negative and the glass of the printing frame must be scrupulously avoided, and it must be remembered that a most insignificant grain of sand or grit is sufficient to smash the glass plates under the high pressure to which they are subjected. The screws must be tightened by commencing at the corners, and evenly distributing the

pressure over the whole plate ; in the same way in opening the frame one must be careful that the whole pressure is not allowed to rest on one screw.

The time of exposure depends in the first place on the light, the composition of the printing solution, and the density of the negative. In average good sunlight in the summer, it is from one to two minutes for line work, and two to three minutes for half-tone work. The more vertically the rays fall on the frame, the more sharply the dots develop, and by using a tube, blackened inside over the printing frame, the best results are attained, yet the difference is so infinitesimally small in direct printing on metal that it is hardly of any advantage to use it. The case is different when during a long exposure, the light has to pierce a thick gelatine film. For the wash-out and swelled gelatine processes it has been customary to use printing frames with a series of long square tubes extending in front. The frames were also arranged on a turntable so that they could be directed towards the sun irrespective of its position. By this arrangement lateral action was avoided, the lines were not so much thickened, and extremely sharp dots in the shadows were easily developed. In the albumen films relief is out of the question, and the dots are far less subject to spreading, hence the rare use of tubes.

After exposure the plate is taken out of the frame and the film coated with transfer ink. The ink is evenly distributed on the ink slab with a roller and the plate well warmed, then rolled until it has taken a grey coating. With a single roller an even film is seldom obtained, hence a second rolling is given, as soon as enough ink is on the plate, with a clean soft leather, velvet, or compo. roller. The plate if desired can be warmed again and rolled over in different directions. There is no need to be afraid that the albumen film will be injured. I have never had a single case where damage has been caused by even the heaviest rolling, except when the roller was gritty or had fragments of the metal sticking to it. A light grey, shiny coating is just right. If too much ink has been put on the plate, it can be removed by sprinkling with turpentine, and rolling again, or the second roller is cleaned with turpentine, the plate once more heated, and the excess of ink removed by a quick rolling. The development can be commenced at once. If the exposure has been correct the albumen unacted on by light dissolves directly it comes in contact with the water, and it needs only a slight circular rubbing with a tuft of cotton under water to remove the ink which has lost its albumen support. If the ink smears through rubbing too strongly in the shadows too much has been applied, or it is too greasy, and has

then to be remedied by drying in the air. If on the contrary it is difficult to rub off the ink it has been too stiff. In this case rolling up on the slab with a few drops of turpentine or oil of lavender is useful. If the plate develops in some parts with difficulty whilst the other parts are all right, the cause may be want of contact in the printing frame or that the part in question was overheated. A slight over-exposure can be corrected in most cases by developing in water containing ammonia or bichromate. Add to a glass of water a few drops of ammonia until the smell is distinctly discernible, and develop with this solution. Too much ammonia will dissolve the ink. If the negative was all right the making of a perfect print is very easy. The picture develops plainly and surely, and the finest dots in the shadows can be opened with the same ease as the lights. On the other hand if the negative is faulty, and with the best operator it is not always possible to make a perfect negative, simply because there is no time, owing to the urgency of the work, to make a second or third exposure, the printer has to make up the defects as far as lies in his power. A very frequent case is that the dots in the shadows have insufficient density; here it is best to make the exposure as short as possible, and use very little ink. On the other hand, if the shadows are too open, or the high-lights too closed, the exposure should be

increased and more ink applied in the rolling up. Besides this we must take into consideration that as a rule clear sunlight gives softer, and diffused light harder prints. When the plate is developed rinse it with clean water, and dry at once with a soft leather pad, or with heat, to avoid water markings. The plate is now ready to pass from the hands of the printer to the retoucher. It will be seen that the albumen process is so simple, certain, and quick as to enable in urgent cases a print to be made in less than fifteen minutes from commencing the coating.

The Enamel Process.—Now I come to a process which in an incredibly short time—it is hardly more than three years since the appearance of the first vague reports of it—has been introduced into all the engraving establishments in the United States, and has very quickly won the hearts of all practical men. I mean the enamel process on copper. A long time before its introduction, here and there etching was done on copper, and generally with good results. In this matter the Moss Engraving Company was in advance of all others in America. Printing on copper does not differ from zinc, and it is not necessary to add a single word to the description of the process already given. The advantages of copper over zinc were soon recognised, because of its purity, close structure, polishing quality, its durability in the

press, and the property of giving smoother and softer proofs than zinc. In perchloride of iron, too, we have an excellent medium for etching, and thus in all ways attention has been directed to copper blocks. They very soon gave a better quality work and were better paid for. But the highest step in perfection of copper etching was attained when in the enamel preparations—the originator of which, so far as I know, was Ives, of Philadelphia, or after others, Levy, of Philadelphia—two new acquisitions to the existing qualities were obtained, viz., a durable etching ground, and a better printing surface for the press. Since the process became known it has been re-invented many times, new formulæ have been worked out, and have been carefully guarded by the initiated. Owing to the ease of etching such prints on copper, half-tone etchers have sprung up in America like mushrooms from the ground. Those who were not much good for anything else called themselves copper etchers, and were engaged on good wages. The continual changing of the workers from one establishment to another soon put an end to the last traces of the secret, and to-day the enamel process has almost entirely supplanted the albumen process for half-tone in America. In a way that can be seen at a glance, I give on the opposite page the composition of a series of preparations, some tried by myself and others obtained from capable printers, who

have worked and become acquainted with their qualities.

	I.	II.	III.	IV.	V.	VI.	VII.
Water.....	7 oz	7 oz	7 oz	7 oz	7 oz	7 oz	7 oz
Fish glue	2 oz			4½ oz	1½ oz	3½ oz	
Gum arabic ..		1 oz					½ oz
Albumen			4 oz	4½ oz			2 oz
Sugar						100grs	
Ammonium bichromate..	48grs	100grs	120grs	90grs	30 grs	200grs	120grs
Chromic acid.			12 grs	3 grs	15 grs		
Liq. ammonia.	1 dr	some			17 mms		some
Alcohol	1 dr						
Chrome alum.	15grs						

(In translating the above table from metric weights and measures, fractional calculations have been omitted, but the figures given will be found near enough for all practical purposes.—TRANS.)

We see from the above what a wide difference exists in the concentration of the solutions, and the chromate contained in them. Consequently the action, according to their composition, is somewhat different. The recipes I. and II. are excellent in every way, and have been "tried in the fire," being worked under my supervision for a long time.

The principle of all enamel processes is that a metal plate is coated with a sensitive solution, exposed under the negative, and developed with water, the film being finally hardened by means of heat (enamelled), and thus rendered durable against the action of the acid. To illustrate the necessary manipulation I choose the gum preparation (Formula II.) The work with it requires

more skill than with the glue preparation, and for that reason, therefore, it seems more fitting to describe it and direct attention to all possible troubles, accustoming the operator to scrupulous exactitude. The entire enamel process is more delicate than the albumen process, and the careless work which is allowable with the latter, generally leads to want of success with the former process. The claims on the photographer and also on the printer are increased.

The easiest way is to buy the gum arabic powdered, the powder being quickly dissolved. Weigh out the desired quantity, put it in a good sized mortar; add as much alcohol* as will evenly damp the powder, and whilst uninterruptedly grinding with the pestle, pour in gradually half the necessary quantity of water, until a thick liquid is obtained. If the work is done well the troublesome lumps formed by the gum are avoided, and the solution is effected in a few minutes. After this the second half of the water, in which the chrome salt has been dissolved, is added. A few minims of ammonia are added and the whole poured into a boiling flask, which is put into a water bath and warmed until the contents are entirely dissolved. After the solution is cold it is tested up to 11° with a hydrometer for heavy liquids, and filtered

* The Author does not give alcohol in formula II. in preceding table; probably an inadvertent omission.—TRANS.

through damp cotton wool. The preparation keeps for at least eight days. Its sensitiveness to light increases thereby, until at last insolubility of the film is produced. If there is a suspicion that the gum arabic is adulterated, then the arabin acid is precipitated with alcohol, and the gum washed, dried, and afterwards dissolved in the necessary quantity of water.

It is a condition in obtaining a good film that the copper employed be perfectly even and flat. If the plates are in any way bent or have partial elevations or depressions they are useless; on one hand because they make the equal distribution of the solution impossible, on the other hand an absolute contact with the negative cannot be obtained. If there is no polishing machine available the best way is to buy the copper plates ready polished. They are then cleaned with finest emery powder until free from grease and flowed under the tap. The coating with the solution is done in a similar way as with albumen with this difference only, that after the first coating a second is applied, which has to be flowed off in a contrary direction. The whirling has to be prolonged, but not too quick, and the plate dried carefully with heat by keeping it in a horizontal position. Too much heat makes the film easily crack, and though the cracks may be hardly perceptible the plate in such a state will, of course, be useless. The

drying is done in a few moments. The duration of exposure is, on account of the thickness of the film, a little more than for albumen. After the exposure the picture should be seen in a soft brown colour on a brilliant golden yellow ground. The plate is put into lukewarm water, and the film allowed to soften at least for five minutes, whereby a swelling up and crinkling in the shadows indicates over-exposure. After this place the plate in an aniline bath to make the picture more visible, for instance, in a solution of methyl violet in water, which colours the image intensely either in a few seconds or several minutes, accord- to its strength. After all the parts which have not been acted on by the light are washed away under a strong rose tap, the picture should stand like a blue print on the bright metal. A blue veil between the dots and lines shows that all the soluble gum has not been washed out. This is, by reason of over-exposure, difficult to attain with cold water. In such case if the shadows cannot be opened sufficiently, use warm, or even hot water. We thus have a greater latitude in exposure, with- out impairing the result. If the film cannot be washed out evenly, remaining dark-coloured and indistinct in places, there has been faulty contact in the printing frame, and the plate has to be pre- pared again. The dots acquire their full sharpness only after drying. The plate can be left for a

short time in a warm room, but the best way is to flow it with alcohol, whereby the aniline is for the most part washed away. When fully dry, which will be in a few moments, the hardening or enamelling of the film follows. The state in which the plate is before enamelling, would hardly offer much resistance against mechanical injury, much less to the action of the acid, unless a solution of perchloride of iron in alcohol was used. The plate is taken with a pair of tongs and gradually warmed over some source of heat, for instance, a single or up to a three-fold Bunsen burner. After some time a change is noticeable. The blue gets pale, then ashen grey, and entirely vanishes at last, the aniline being destroyed by the heat. In this state no trace of a picture is to be recognised on the plate. The metal has an even yellowish red colour. Gradually some parts begin to take a feeble brown colour, the shadows first appearing with increased strength, and an oxidation of the surface of the copper goes hand in hand with the appearance of the darker and darker shade of the picture. The latter gets covered with a brilliant golden and infinitely thin film. If at the same time the picture has darkened to a deep chestnut, the burning of the plate is accomplished. Otherwise the plate is carefully heated further, whereby the brilliancy of the copper changes more into a reddish colour, and in places vanishes altogether,

giving place to a dull yellow red with a dazzling brilliancy. It is now high time to take the plate from the stove and cool.

A well treated plate should be as follows :— From the clear and brilliant ground of copper, which is free from any trace of adherent gum, the picture appears in a soft chestnut brown colour like an albumen photo. The film forms a relief of discernible height, the dots have a pyramidal shape, and enlarge to their base. Examined directly vertical every dot appears to have a ring round it. We notice also that as a rule, particularly with films of considerable thickness the finest dots in the shadows are not entirely washed out down to the ground of the copper. This is because the rays of the sun have crossed inside the film, and hardened the layer of gum next to the copper. Under some circumstances this is no disadvantage, as the etching liquid attacks these spaces last, when the lights have already a moderate depth, and it is thus not so easy to etch the shadows too grey. The hardness of the relief and its adhesion to the copper is very considerable, and mechanical injuries cannot easily result. Scratching with the finger nail is impossible. The colour of the picture should be uniform in all parts—a deep chestnut brown. Dark patches locally are caused by depressions in the copper, producing a thicker

film in those parts when coating the plate, and by want of contact between the negative and film in printing. This as a rule is readily recognisable on the plate when it leaves the aniline bath. In some cases a strong washing under the water tap, or pouring hot water on these plates is of use, but generally a fresh plate has to be prepared. If on the other hand there are several patches which are too light, with a tinge of yellowish green, the film in these places was too thin, and a danger of over etching exists. The cause of these thin places lies also in the unevenness of the copper, or in too vigorous whirling, or in the solution being too thin. Plates of large size particularly are seldom entirely even, and give most difficulty. If entire evenness were not such an important factor, plates as thin as paper could be used, the cost being, of course, far less. For instance where there is an electrotyping plant at hand, such plates prepared by galvanic deposition on lead or silvered copper plates might be had almost for nothing, as has been done by the Moss Engraving Co., in New York. Any desired thickness may be attained and the purity of electrically deposited copper is beyond question. Nearly pure copper is of a light red colour, and this is most suitable for the process. Numerous alloys of copper of a dull yellow colour have been brought into the market in New York, but experience with such metal has been unsatisfactory, and users

have returned to pure copper. The alloys do not always show on burning, the nice brilliancy of colour which is such an important point in recognising the necessary duration and strength of heating. Besides, the etching process does not always progress with the desired certainty. Even when good copper is used, if the washing out in development has not been sufficient the plates will not burn clean, much less etch evenly. If the burning-in has been carried too far, until the colour is nearly black, the film in many cases cracks, and the print, through partially carbonising becomes useless. Yellow films, which are feebly burned are also useless, because they get too soft in the etching bath, and naturally result in the loss of the plate.

What I have said on the printing of copper equally applies to brass, but this metal is not much used. There is no sufficient reason for departing from copper. Of course, enamel prints can also be made on zinc, but the latter does not stand so well such a high temperature. It changes its structure, becomes crystallised, breaks by bending, and etches slowly with great roughness. If zinc is chosen as the printing metal, albumen gives the best results.

In a similar way to that already described the other enamel preparations are used, and those who know how to work with one will be able to handle them all. Fish glue preparations require to be coated

more thickly than gum, if they are to have the same resistance to the acid. A modification in the character of the negative is consequent upon this. As already mentioned the dots in the print have a pyramidal shape, and this is accentuated with glue. A strong printing of the dots being necessary, a slightly longer exposure renders them larger at their base. If the clear spaces in the high-lights of the negative are very small, this spreading in the printing is an advantage, the danger of over-etching being lessened. But if the dots in the shadows of the negative are very fine, or are not very dense, then it is nearly impossible to develop them (without losing the delicate detail) so that no blurred patches remain. Thus negatives for the glue preparations must be well closed in the lights and open in the shadows, that is to say they must have solid dots in the latter portions. Negatives which give good results with gum are often useless for glue, except when the solution is thinned down. The most feeble relief is given by enamel preparations with albumen alone, for instance, formula III. They require, therefore, negatives with clear glass shadows, broken up by very fine dots, and with open lights; negatives for the gum processes stand about midway in these requirements. Fish glue has one advantage over the gum, viz., its high solubility in water, which shortens the development a good deal, and has further the quality that

the films never crack. A good kind of fish glue is Le Page's Liquid Glue, manufactured by the Russia Cement Co., Gloucester, Mass., U.S.A. If we want it more purified, which for the most part is superflous, some albumen is added to the solution, which is well shaken, heated until the albumen coagulates, and filtered. In making up formula I. the fish glue is dissolved separately with 4 ozs. water, the bichromate in 2 ozs. of water, and the chrome alum in 1 oz. of water. After dissolving all together, the alcohol and ammonia are added. Owing to the solution not

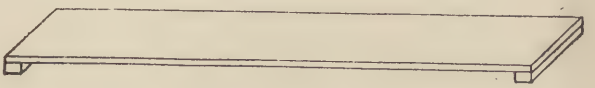

Fig. 42.

keeping well, and the fact that it is easily prepared, it is advisable not to make more than can be easily used in one day. By working with very fine screens, as, for instance, 150 lines to the inch, thick films are out of the question, and it would be useless to adopt the above formula without first thinning it with water.

Retouching of the print is very simple, and is limited to stopping-out lost dots caused by dust and impurities in the collodion, the stripping collodion, or the printing solution. In this operation the hand-rest (fig. 42.) is useful, the hand

resting on this whilst working. For albumen printing ink, and for enamel, asphalt varnish is generally used, both being thinned down with lavender oil; or shellac mixed with aniline colour may be used. The work is quickly done with well worked and pointed camel hair brushes and a strong magnifying glass with small field, but not too short focus (so as not to come into conflict with the brush). It is not even necessary to imitate strictly the shape of the dots, the engraver being able to take away in a moment any irregularities with a few strokes of the graver. One must guard against the fingers coming into contact with the film when retouching, as the slightest deposit of grease from the skin will disturb the evenness of the etching process. From the retoucher the plate goes to the etching room, and we will there watch its further progress.

CHAPTER V.

ETCHING.

Before going on to speak of the etching process I should like, for a few moments, to direct attention to the point of view from which the etching should rightly be conducted. We have seen how the original is broken up into dots, and how the divided negative, by means of various preparations, is printed, and attains the necessary acid-resisting properties. The print shows a picture with the half-tones in dots, and how by enlargement the dots combine and form lines. From these dots and lines all the details of the original are composed. The centres of the dots being the same distance apart, the formation of a detailed picture is produced, with light and shade, by changes in the shape and size of these dots, which vary from almost imperceptible fineness to such a size that they merge into each other, and form an evenly flat surface without detail. From 400,000 to 1,800,000 dots, according to the fineness of the

screen, are contained in a half-tone of about 7 × 5 inches. Strictly speaking, the changes in size of these dots, by reason of their close proximity and smallness, are very slight. But besides the change in size the dots undergo in the same manner a change in shape, which is more marked in proportion as the original is rich in detail, and according to how sharply the focussing is done, as the dots are thereby forced to conform to the lines of the original. In this way very differently shaped figures, with characteristic, sharp outlines, are produced, but of minute proportions. Fine modulation in the high-light parts is often attained through such insignificant differences in the shape and size of the dots as can be only perceived with a magnifier, and only give value by their effect in mass.

If upon this consideration we draw a conclusion as to the nature of the etching, we see that the leading idea is that, corresponding to the fineness of the print, the deepening has to be conducted in a very careful and exact manner. Having to deal with such insignificant, yet nevertheless such important, transformations in the shape of the dots, it follows that we must endeavour to preserve in the etching their characteristic shapes. The parts most exposed to the destructive action of the acid are the isolated dots. They have a tendency to round off and diminish, bringing about in this manner a loss of those little differences by which the delicate

shades are expressed. In a less degree the dots are attacked in the lights, where they are isolated on all sides, and also where they are joined together. The uneven action of the acid results in the latter being disconnected, and an abrupt transition from light to shadow results at the expense of weakening the whole, because the isolated dots are more quickly etched finer than those which are in contact. The danger of losing detail in the lights and softness can only be remedied apart from making the film fully acid-resisting by omitting rocking, brushing, and rubbing, as much as possible. The more the etching brush is used, the quicker the etching advances, but the lights are rendered proportionately whiter, whilst the shadows are relatively kept back, and the whole impression is harder. For forming an acid-resisting film the enamel preparations on copper are unsurpassed, and their general advantages are not to be underestimated. Those who are familiar with the etching of photogravure plates know how quietly and evenly perchloride of iron etches compared with the turbulent action of nitric acid on zinc. The enamel films are also strong enough to allow the plate to be deepened with one etching, without greatly reducing the dots, and it is so much easier because the plates can be left still in the bath. As to the necessary depth of the plate no exact guide can be given, because plates are subject to many

different circumstances, as for instance the fineness of the screen, and the quality of the printing and paper. In any case, shallow-etched plates, if they are only deep enough to give clean prints, are to be preferred on account of their softness and delicacy. Considerable depth is only in its proper place where the printing leaves something to be desired.

Arrangement of the Etching Room after the American Pattern.—Line work is generally etched on zinc in America, but in a radically different manner to the so-called Austrian or French etching process. First the deep etching is omitted as an obsolete and almost forgotten process. Then the plates are not rolled up in order to cover the sides of the lines whilst obtaining the depth. Instead of this, resin powder is brushed on to the sides of the lines from four directions, melted on, and the step formed is smoothed away in the etching. This is repeated three to five times, and in this manner the clean-etching (finishing) may be omitted. It is no conjuring for a good etcher to finish a line plate in half-an-hour or less. In principle half tones are in no way different from line work, and generally the same method of etching them is observed.

To the arrangements of the etching room belong two flat boxes with covers, containing sieved resin and dragon's blood respectively. Dragon's blood is a vegetable resin, which in its

pure state has an intense red colour, and is used to cover the steps of the etching. This is applied with a four to six inch thick camel hair, such as is used for the finest etching. The finest resin powder is obtained by grinding in the colour mill. The resin is pulverised in a mortar, well mixed with water, and the thick liquid poured into the

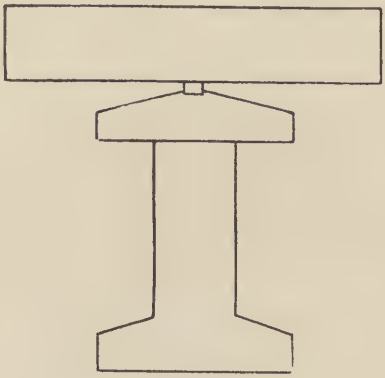

Fig. 43.

mill. In establishments with power, and few are without it in America, there is no difficulty in connecting the mill with the engine. The thick liquid when well ground is spread out on a plate to dry, and finally sieved through bolting-cloth. There is nothing new to say about the etching tubs in use. They have generally the shape of fig. 43, are well pitched inside, and provided with an outlet. The

heating of the plate over a Bunsen burner is not desirable, except with plates of small size, because even heating is difficult, and besides this the plates are apt to bend, having to be held with tongs. Where no steam is available, a gas stove (fig. 44) with a series of Bunsen burners will do the same service. Many etchers prefer to take the stove plate off, and fix instead a wire grating or grid a little higher than the table. By means of an iron hood the heat is distributed as evenly as

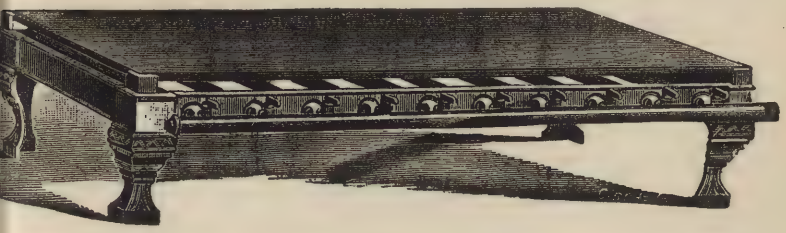

Fig. 44.

possible. The plates are taken up with tongs or carried on little shovels of the shape illustrated by fig. 45. To cool the plate bellows are used, or the hot plate is laid on a heavy iron slab. Another way is to rub the back with a rag wetted with cold water. Turpentine serves to clean the plates when etched. If the heavy first cost is not objected to, the best thing is to buy a large iron or lead trough, filled with concentrated potash solution; the plates to be cleaned are placed on a rack having a

handle by means of which the whole is dipped into the solution. Here they remain until all the colour is destroyed, and the resin dissolves. For covering the back and margin of the plates, asphalt or shellac varnish is used. In case of emergencies, one or more leather rollers with accessories need to be at hand.

The Practice of Etching.—The dusting and melting of the resin upon the half-tone albumen print is done in the ordinary way. The plate is made as warm as the hand can bear, the powder being then put on thickly, and brushed with a quick but light movement until the bare parts of the plate are clean. Care must be taken that, especially in the shadows, there is no resin left adhering, as this will obstruct the even action of the acid. Resin melts easily, and the heating should therefore be done slowly and carefully, and not more strongly than can be recognised by the melting of the resin and changing colour on the surface. On account of the easy melting of resin, many etchers prefer a mixture of it with dragon's blood, which has a higher melting point. The latter resin is not suitable by itself for the first dusting, on account of its friability, and lack of adhesion to the zinc when melted. The acid bath

Fig. 45.

is strong enough when it has the strength of vinegar to the taste, thus containing one to two ounces to the quart. With slight rocking of the bath, and as little brushing of the plate as possible, the progress of the etching solution is watched. Often sufficient depth is attained with one etching. If this is not the case, there are several ways of preparing the plate for the second etching. The plate, whilst wet, may be rolled up with transfer etching ink by using a good glazed roller, and charging the roller with very little ink, so as to avoid the formation of steps in the etching, and thus save the clean-etching. These two methods are too well known to need detailed description. Every etcher is familiar with them. But the way in which the etching is continued in America would be new to many workers in this country.

The first etching has to be so deep that the ground of the metal, and particularly the sides of the dots and lines, are etched without roughness, and this applies to line work as well as half-tone. The plate is drained off, dried on the stove, and heated so strongly that it can hardly be held in the hand. In this state the plate is conveyed to the dusting box and heaped up well with the dragon's blood. The resin, which has been rendered sticky by the warming, takes the dragon's blood well, and the drawing is covered with a layer of red resin. The plate is laid on the left-hand corner of the box,

and the excess of powder is dusted off with a camel hair brush, but the brushing must be only in one direction, from left to right across the plate and back into the box. The intermediate spaces of the picture which are already sufficiently deep are filled up with powder, whilst in the lighter parts the zinc appears clean again. On the left side of each dot or line a slight layer of dragon's blood remains, which attaches itself firmly to the step formed by the previous etching, and this layer is sufficient to protect the dots in this place from over-etching. The quantity of powder deposited can best be noticed by holding the plate horizontally away from the light, and looking at it in an oblique direction. The powder is now melted on, whereby it changes its colour to a dark brown. The plate is cooled off until warm enough to repeat the above operation again, with the difference that the brushing is done in an opposite direction. In this manner a second quarter of the sides of the dots or lines is covered with the powder, whilst the ground of the picture remains free from it. The plate is heated again, and the brushing and melting continued for a third and fourth time in direction at right angles to the last, as shown by the arrows in the diagram (fig. 46). In the end, every raised part of the drawing is entirely surrounded by a narrow wall of melted resin, as illustrated by the dot (fig. 47). The operation is not entirely easy,

and requires practice and experience. The manner of handling the brush cannot be explained. If the heat applied in the first operation was not sufficient the picture does not take the dragon's blood readily in the latter heatings, and it is difficult to brush the resin from the ground to the sides of the lines or dots, the resin in a certain measure smearing the zinc, and leaving streaks. If the plate is too hot when introduced into the dragon's blood the latter sticks

Fig. 46.

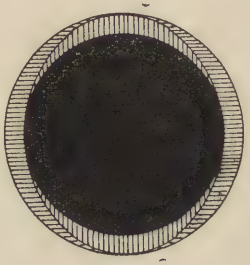

Fig. 47.

everywhere, and cannot be brushed away from the ground of the plate. In this case the best thing to do is to clean the plate and roll it up with ink. If the plate is over-heated the resin commences to smoke, and that is a sign that it is partially carbonised, and in this state has lost its acid-resisting qualities.

In the second etching, the bath is strengthened with a certain percentage of acid, the endeavour is to obtain the desired depth on the one hand, and

on the other the smooth etching off of the fringe formed by the resin. If this fringe is too great—and beginners will, as a rule, get it too large—a step is left which can only be removed by a finishing etch. A properly-conducted etching should by each succeeding bath remove the step formed in the previous bath, and so save the fine etching, If the resin after the second etching is deep, clean, and sharp, the resin, ink, and backing varnish are washed off, and a proof taken from the plate.

For etching enamel copper and brass plates, commercial, technically pure perchloride of iron is dissolved in a much smaller quantity of water, *i.e.*, water to the extent of one-third the weight of the perchloride. Test the solution to about 35° Beaumé, and filter. A bath long in use turns to a green colour, and is thick and muddy from the separated oxide, etching very slowly. Suggestions have been made for purifying such solutions, so as to bring them into a fit state for use again, but I see no advantage in business-practice in it. The profit derived in one way would be lost in another—in trouble and waste of time. The best way is to filter and dilute the old bath, using it for a few plates and then throwing it away. A handle (fig. 48), with two stirrups as illustrated, may be made of strong insulated leading-wire, as used for the electric arc lamps, or in default of this a piece of iron wire painted with lac varnish. This can be

bent to suit all sizes of plates. The copper plate to be etched, with its back coated with varnish, is fixed in this handle by two diagonal corners in the stirrups, film downwards, thus forming a good plate holder, which for quality and cheapness is unsurpassed. The plate thus comes film downwards into the perchloride of iron solution, which directly commences to attack the copper. The plate is moved a few moments to and fro, making

Fig. 48.

sure that everything is in proper order, especially that there are no air bubbles under the plate, and it is left for five or ten minutes to itself. After this it is taken from the bath, the perchloride of iron rinsed off, and the plate examined with a magnifier to ascertain the depth obtained. It is a pleasure to look at such a plate. It seems as if a picture had been produced on the red ground of the plate as if by magic. Every dot stands there sharp and un-

injured, and the intermediate spaces are etched out as smooth and round as can well be imagined. If the necessary depth is attained, there is nothing more to do than to dry the plate, to clean the deposit away in the deep parts with a hard brush, and to take a proof. Some probable causes of failure I have partly mentioned in the preceding chapter. Softening of the film through insufficient burning is often perceived in time by scratching the margin with the finger nail. If this is the case and the coating of the plate is otherwise uninjured, the film is washed off with hot potash solution, and rolled up. If the acid does not attack evenly, and particularly if the dark parts will not open, then the print was over-exposed, or not sufficiently washed out, or the contact in the copying frame has been imperfect. In this case use the etching brush, and in extreme cases even a hard bristle brush, and by this means allow the perchloride of iron to attack the copper. If the film has unusually slight resistance to the acid, the burning has been too short, or it has been extremely long—which can be determined in either case by the colour of the enamel film—or the coating was too thin.

Except for these defects, the result of faulty manipulation, it is possible by means of rolling up or light etching, to improve at the right moment and in the right place the result of a faulty negative,

and to save the work. But I repeat, all these tricks are only botchy work. In making them a rule we should fail to appreciate half-tone as a mechanical process. The less the plates need artistic retouching the more successful will be the result. Retouching implies a previously-incurred fault, and no one will contradict me if I hold it more important to keep in mind the avoidance of these faults from the beginning, than to waste our best faculties in repairing them when they have happened. We are so easily induced to let pass a slightly faulty negative, with the consolatory excuse that the defect can be surely remedied by the printer or the etcher, or without fail by the engraver. The printer thinks he has done his duty in having printed the negative mechanically, and does not feel induced to do more, even if he could. He may get even, in addition, a few ugly dirt stains on his plate, but "they are so easy to retouch." The plate is also a little over-exposed, but this does no injury at all, because "the etcher can leave it so much longer in the bath." This the etcher does; even something extra. He brushes and brushes until the dots are as fine as possible, yet because the shadows are heavy and blurred, the shading in the lights has gone, softness is out of question, and it is not altogether his fault. Where too, are the engravers, who are armed with roulette and burnisher? If the engraver who

receives the plate in the last instance is overwhelmed with work, then we can conceive what kind of result will be forthcoming. And this all through mere bagatelles of faults which could have been very easily avoided.

CHAPTER VI.

FINISHING WORK. ENGRAVING.

From the etched plate, a rough proof is next taken. The fate of the plate depends on this proof-taking, and care should be taken in this proceeding. To use for the sake of economy, cheap paper and bad ink would be bad policy, the proof having to decide whether the plate is serviceable or not, and to guide the engraver as to the necessary retouching to be done. It is useless to suppose that in all cases, a plate, except for trimming the margins, is ready for printing from when it leaves the etching bath. Notwithstanding that the manipulations already described form the principal part of the work, it is left to the engraver and finisher to amend any faults which have arisen in the foregoing processes, to correct light and shadow to the standard of the original, to bring up lost details, to set up pointed lights, to cut vignettes running into pure white, in short, to put the last touches on the work, and to give the reproduction

the highest attainable degree of perfection and artistic merit.

For this the rough proof serves as a guide, and it is conceivable that its quality must not be indifferent. If the proof is satisfactory, the depth of the plate sufficient, and there are no bad faults present, then the engraver cuts with the graver the

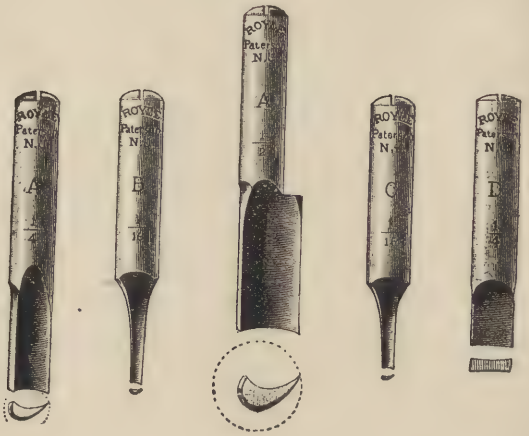

Fig. 49.

margin line. When previously speaking of stripping the negatives, I mentioned the easiest way to obtain a sharp margin line. The margin of the plate prints black, in consequence of the straight cutting of the edges of the film, enabling the engraver to determine, by scratching with the graver, the thickness of the margin line. The superfluous

edge is removed with the bevel plane specially constructed for the purpose, or better with the routing machine, as used in America since the establishment of the reproduction business, and saves the troublesome, time-absorbing and unhealthy operation of deep etching. The principle of all these machines is that a cutter rotates at a high speed and can be moved along the lines to the desired depth. Cutters of different sizes (see fig. 49 in natural size) enable different large spaces to be taken away even to the diameter of only a few millimeters. The advantage of the routing machine *versus* the etching process is an enormous one, and it is astonishing that this machine has made so little progress in Europe. Fig. 50 shows the system most in favour in America. The plate is nailed on to a board, and together with it fastened to the machine table immovably by means of clamps. By two levers, of which the left lies on a bracket and can be lifted, lifting the cutter at the same time, the latter is moved in all directions over the plate. Two treads on the base of the machine bring the cutter into and out of action, respectively raising or lowering it to deepen plate while working. A screw applied at the upper part of the cutter, allows its being raised or lowered, and thus the plate can be routed out in different depths, shallower in the fine parts and deeper in the larger spaces, or allowed to go

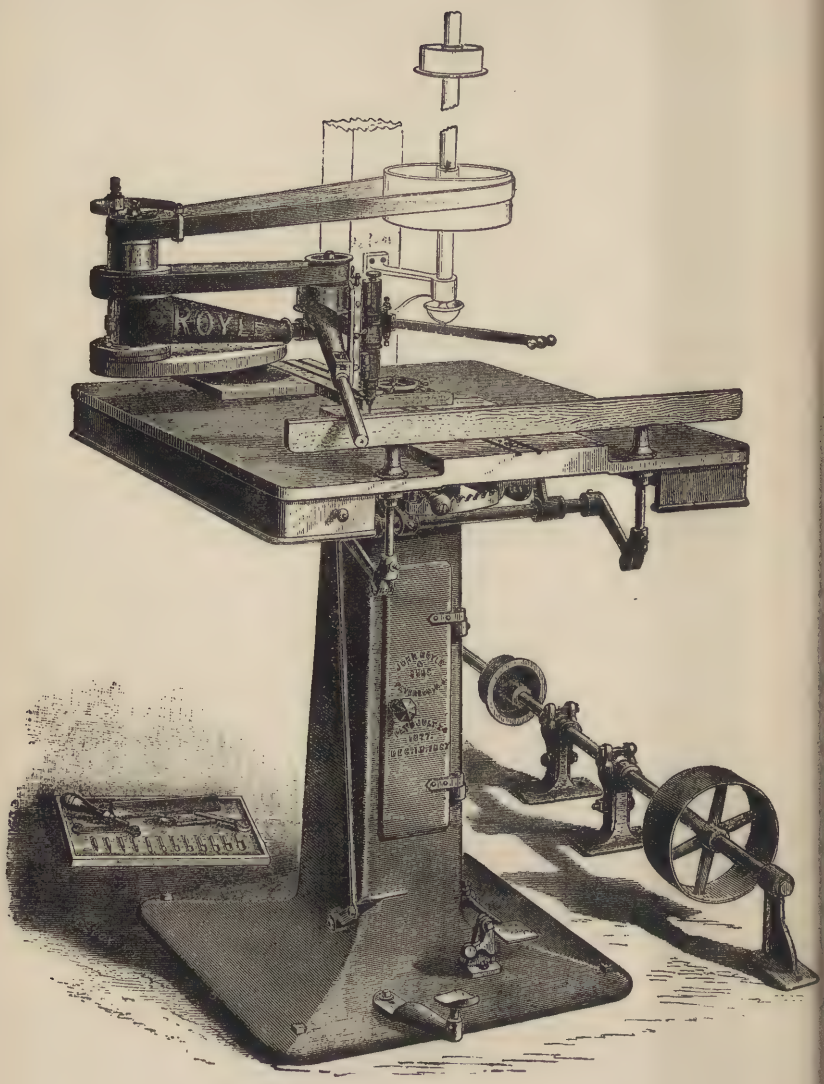

Fig. 50.

right through to the wood. One horse power is sufficient for driving the machine, and by this the cutter should make about 9000 to 12,000 revolutions in one minute. The shape here illustrated is the Radial Arm Routing Machine of Royle. It costs £57, and plates of 40 inch length can be routed with it. In other systems, which are not so good, the cutter is fixed whilst the plate is moved to and fro under it.

In routing the margins of a half-tone the cutter is run along the marked line of the engraver, but does not cut away the outer margin, leaving this to give a better start for the ink roller, when taking a clean proof. Where no routing machine or shoot block is at hand, the etcher has to undertake the tiresome work of deep etching, by coating the block to the marked border with leather varnish and then performing the deep etching in the ordinary way.

Thus prepared, the plate goes back to the engraver. Occasional markings or scratches derived from the foregoing manipulations or badly retouched spaces, are worked over with the graver, until the dots have the shape of the neighbouring dots, and in printing do not show any defectiveness. Holes eaten away by the acid are more difficult to repair, and they appear white in the print. There is nothing to be done but to solder them, equalize the surface with the scraper, and engrave

out with the tool. For lightening too deep shadows which are without detail, the roulettes (fig. 51) are used, the teeth of which have about the distance of the dots of the screen. Sharp contours and outlines can be brought up with them, giving the picture more life and roundness.

Fig. 51.

Fig. 52.

Strong high-lights are often taken out or the dots are cut down to the utmost fineness. Where it is required, on the contrary, to deepen the spaces which appear too light the burnisher is applied (fig. 52). It is rubbed with moderate pressure on the parts concerned, whilst carefully

keeping to the contour, and the dots are made a little larger. They will thus appear slightly darker in the print. In this manner particularly, the details in the high-lights are brought into evidence, and grey shadows without strength are deepened. We must not forget that by polishing the plate with the burnisher, the surface in these parts lies a little deeper and will not print without overlaying, which if not done would give the contrary of the desired effect. If the plate was printed with enamel, and needs a thorough treatment with the burnisher, it will be better to wash off the film with a hot soda or potash solution, as the enamel would offer an important resistance to the burnisher. Often the film is burnished only in the lights and allowed to stand in the shadow. The thickness of the film on the darker parts forms then a kind of natural relief, through which the lights receive less impression in printing. Shallow etched plates must be carefully treated in using the burnisher, or they will be rendered more shallow, and fill up in the press.

Preparing and Clean Proving of the Plates.—Hand in hand with the work of the engraver goes the skill of the proof printer. It seems so easy, yet it is so difficult to obtain a perfect proof. It is to the interest of the manager of the business to obtain the best possible printing

result from the plate to be delivered, as this determines the value of the block, and so gives a pattern to the machine printer to follow in making ready. The more beautiful the proof is, the more excellent will the edition be, as the printer endeavours to equal the proof as far as possible. Many blocks made from suitable originals need hardly any preparation for the handpress, being of the same value of tone as the original picture. But this is seldom the case, except in work of small size. The making ready is done in a two-fold way, from the surface and from the back; the first has for its object to remedy unevenness in the metal, or to give more or less pressure to certain parts. This is performed by taking a proof on strong paper, and cutting out parts which print too dark or not satisfactorily on account of the unevenness of the metal. The parts which are intended to print darker, such as the shadows, are cut out of another proof, and these, with the sheet corresponding to the lighter tones, are respectively attached to a second proof, which serves as a guide for the position of the pieces pasted on. The whole picture, face down, is pasted on the back of the block. The most important preparation is, however, the overlaying. The block is placed in the middle of the press bed and the position is marked. If there is no other arrangement this is done by pasting two pieces of paper

on the table, touching exactly with their corners the two diagonal corners of the block. Then a piece of glazed printing paper of sufficient size is pasted in the middle of the press tympan, and a proof is taken on it. On to this is later on pasted the overlay, and in this way it is possible to cover the block correctly in printing, if it is placed in its correct position between the two paper marks. Should the press not have a fixed tympan we can manage it in a way by laying the block on one folded half of a large, strong and smooth sheet of paper, marking the position of the block by going round it with a pencil, afterwards folding over the second half of the sheet on to the block and taking a proof. From fine tissue paper (the tissue being of different thicknesses but free from any lumps) proofs are taken, and parts of these are cut out as overlays and pasted on to a proof on smooth stout paper. This, in turn, is pasted on to the upper part of the sheet on which the block is laid. The idea is to produce a relief which at the moment of impression gives a different pressure to various parts of the plate, strong in the deep shadows, and softer towards the high-lights, so that in consequence of an unequal deposit of ink from the block on to the paper, the print acquires more strength and roundness. I have mentioned above that through the work with the burnisher the surface of the block on the overworked parts is hollowed.

The effect is that by a flat printing these parts are exposed to less pressure, and on account of this fact the ink is not so well taken up. These parts have to be overlaid, until the paper takes the ink evenly. In this case the deepest shadows are cut out from the printed tissue paper with a sharp knife, keeping exactly to the contour, and they are pasted on to the paper, to receive the overlay, exactly in the same place as the shadows on this proof. In this manner the deepest tones are overlaid, then the parts which represent the second deepest tone are cut from another tissue paper, and pasted in the same manner on the overlay sheet. This is also repeated a third time, and under some circumstances a fourth time, to obtain a gradation in the shadows.

With the deepening of the shadows goes hand-in-hand a softening in the lights, and if this is not sufficient for the lightest parts, then the latter are cut out from the overlay sheet. If clean work is to be produced, it must be a rule to cut the overlays a little smaller than the parts which you desire to darken, and the cuttings out a little larger, the latter, as stated, lessening the action of the pressure, whilst the former increases it. In all this work do not lose sight of the original. When it is thought all that is necessary has been done, cut out from the overlay two diagonal corners as far as the margin of the picture, as shown in fig.

53, paste the overlay on to the proof on the tympan, and proceed to produce a proof. The smoother the surface of the printing paper, the harder it is calendered, and the whiter it is the better it answers its purpose. The colour of the paper, as well as of the printing ink—with which the block gives nearly as many shades as by colour printing—influences the beauty of the print in a striking manner. Thin

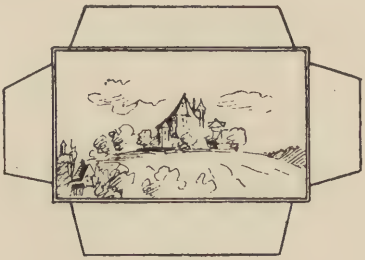

Fig. 53.

paper, even if it is well glazed, makes the impression mealy looking, on account of its inclination to wrinkle and break. Medium strong printboard is most suitable. Also, do not economise on the size; nothing makes a picture more insignificant than a narrow meagre margin. In regard to the printing ink, the best principle is that the most expensive ink is the cheapest in the end. Being better in distribution, less of it is used to cover a considerable surface. It can be understood that

one and the same colour will not work with equal perfection on damp wood-cut paper, as on highly-calendered hard and dry machine paper. The difference of the distance and depth of the lines in a half-tone and in a wood-cut makes this clear. In comparison with the woodcut, where the lines are so deeply cut out with the graver that the ground cannot take colour under any circumstances, the half-tone blocks are very shallow etched, correspondingly to the considerable fineness of the dots and the slight distance between them. There are on the square centimeter 1500 to 8000 dots. The rollers are not without influence on the quality of the print, and every printer knows how sensitive they are to temperature and dampness. Bad rollers impair the quality of the ink. They should be fairly soft, with an elastic surface, yielding to the pressure of the thumb, but not so much as to enter too deeply into the block.

To return to our proof: the block is rolled up, placed exactly in position between the marks on the printing table, and the black margin with a clean mask covered up, the proving paper being held a little hollow and laid in the centre of the plate. The tympan bearing the overlay is laid down and the backing, consisting of layers of calendered cardboard, is laid on, a proof being then taken under moderate pressure. It is very seldom perfect the first time. Generally either one part or the other

is not fully brought up and needs a further overlay. Some shadows may be still too light, or the lights have too much tone, and the engraver finds little irregularities to remedy. At last the final touches are given, and the proof, the fruit of a long series of processes, is completed.

I may point out that the working together in mutual understanding of the proofer and engraver is a source of many advantages, and a further assurance of a good result. It must not be forgotten that in reproduction through a screen fine details, which make, perhaps, the value of the drawing, are often lost, and a sort of fine veil seems to settle over the whole picture, allowing strong contrast to stand out with fair vigour, but effacing the feebler shades without leaving a trace behind. How can this lost character be restored, except by the burin and burnisher of the engraver and the art of the proofer? I do not only refer to the proofer, but also to the machine printer. In breaking up the whole of the picture into a grain, the vigorous contrast between black and white is lost, and cannot be preserved except by heightening it. In the most favourable cases only, could a plate be good enough to need no further preparation, and even then it would only be for a few proofs. If an edition of thousands is required, how can dots in the block, as fine as a needle point, be expected to preserve their shape and deposit a minute patch

of colour, if they are exposed hundreds of times to the same heavy pressure required for taking off the colour in the shadows. The wearing down of a block subjected to such rough treatment will at last have attained such a degree that smudging, loss of sharpness, and deformation of the dots takes place. The contrasts vanish more and more because the colour is heaped up in the lights, and only the skill of a clever printer can prevent all this. It is to be regretted that in this matter we far too frequently transgress by still adhering to the usages of woodcut printing. Yet how

Fig. 54.

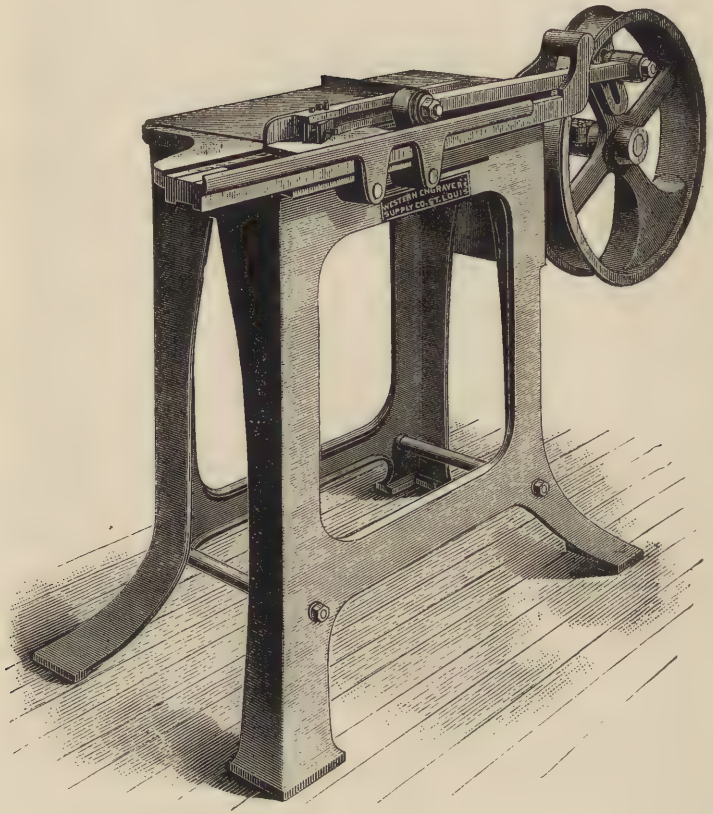

Fig. 55.

much more sensitive is a half-tone block to the slightest difference of pressure, on account of the excessively fine and close grain? The detail is dependent on changes in the shape of the dots, so minute as not to be detected with a magnifying glass, and only the action *en masse* brings them into evidence. Here is large scope for the artistic perception of the machine-minder—and also for the careless!

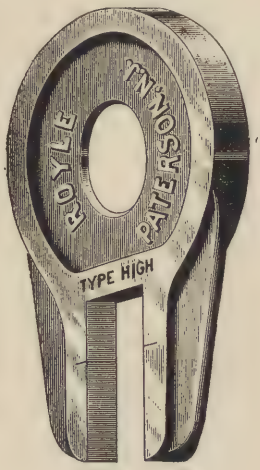

Fig. 56.

The Mounting of the blocks is a purely mechanical branch, to which it is not necessary to draw much attention, as it is hardly within the immediate province of half-tone work. If there is no special drilling machine, the holes for the mounting nails are drilled in the plate with the routing machine. The wood used is cherry or birch; it must, of course, be even and perfectly dry. Well-appointed establishments are provided with a planing machine, but smaller firms buy their wood ready planed to the desired thickness. It is cut with a circular saw to the right size—a

little larger than the plate. If the latter, in the course of the various manipulations — as, for instance, in the etching—has been bent, it must before nailing on to the block be hammered flat on a heavy iron plate. Thin, broad-headed nails, about $\frac{1}{2}$ in. to $\frac{5}{8}$ in. long, are mostly used; screws less seldom. If the blocks are of a very large size, the wood is not used in one piece, but joined in several parts, and if the lines of the drawing are so close—this applies especially to half-tone—that there is no space between them for the plate to be nailed on, somewhat conical holes are drilled in the wood from the back. The plate is placed with the etched side down on an iron plate, the wood block being fixed on to it by means of clamps, and the holes filled up with soldering metal. Finally, the sides are trimmed with the hand plane (fig. 54), or with the power plane (fig. 55), so securing the accurate squareness of the block. The exact type-height is measured with the instrument illustrated in fig. 56.

CHAPTER VII.

VIGNETTES.

The most difficult, but at the same time the favourite kind of reproduction for the printing press, are vignettes—*i.e.*, pictures having no sharp margins, but softened down until they run into clean white. This circumstance makes the production, the proofing, and the ultimate printing difficult. The vignettes are obtained either by hand engraving—as is generally the case in America—or by the etching process; or the subject can be masked in the first instance on the negative. Recently vignettes have been obtained direct in the camera by the action of the light, so that the hand work is for the most part saved, and is limited to the repairing of faults.

On the engraving of vignettes there is little to say. A sure hand and a practised eye must be combined with good taste. When the plate comes from the engraver it is entirely covered with the grain of dots without any distinct margin. By

means of a point the engraver draws the exterior limit of the vignette, as with blocks having a sharp border, and the plate is deepened by routing or by etching along the line marked. Then commences the real engraving work, which is done by guiding the graver between the rows of dots in two directions round the vignette, in such a way that always nearest the outside edge the most is cut off the dots, until the latter have attained at the extreme margin the highest degree of fineness. That this operation is a difficult and time-absorbing one will be quite understood. Therefore, the price of vignetted blocks is higher. In the final printing, on which the utmost care must be bestowed, the rollers must be prevented from bearing too heavily on the edges of the vignette or a black border will result, and this is hardly preventible in rough printing; but in fine work the print should, as in the original, run into pure white. If the engraver, besides his handiness with the graver, which can only be acquired by long and continued practice, is not without artistic understanding, he can bring up some very nice effects. The more strongly the dots stand in the negative the less they are reduced in etching, and the more difficult is the cutting of the vignette, because the engraver has to enter his graver further into the picture to secure the softening down. It is therefore of advantage in making the negative, as well as in etching, to take

care to obtain the highest fineness possible in the dots. The etcher can render the engraver great service by means of stronger brushing of those parts lightening the borders in the etching. This is particularly easy with enamel prints, where the vignette shows up on the copper like a photograph. He etches the plate first to the ordinary depth, washes the plate with water, dips a stiff brush—such, for instance, as is used by oil painters—in the solution of iron perchloride, and brushes the edges of the vignette by steps, frequently washing to prevent the iron forming perceptible markings within the limits of the picture. We can etch in this manner gradually to a very light tone, and the troublesome stopping-out with varnish is avoided. If we would do more, then by all means call to aid the varnish, and stop out the parts which have attained the necessary lightness, but it must be mentioned that it is very difficult to work on an etched plate with a brush on account of the running and spreading of the varnish in the etched depths, so that a proper effect is hard to obtain, and it is difficult to get a sharp line. Therefore, whoever has a good engraver available does better not to go into details in etching. It is, at any rate, not so bad if one or another part lightens up a little too much, because they can be worked over with the burnisher.

It is another matter if you are compelled to

have the entire vignette produced by the etcher. Then the etcher must have the necessary taste, and must strive to attain the effect of the original by partial stopping out and etching. But it cannot be done entirely without the aid of the engraver if we want to make a really good block for printing. In the negative also we can very well help on a vignette. Delicate lights can be well covered with stopping out colour, and gradated contour painted in. If we rub the film with the finger and a little resin powder, then it is susceptible to pencil retouching, and for washes the same service is rendered by "Mattolein."* To avoid the troublesome hand work it has been sought to produce the vignettes in a mechanical way. Although this process has been patented in America the idea is not a new one, and the same thing has been done from the earliest days of experiments with the screen. For instance, if we first give through the screen a full exposure, and then remove the screen, and expose on the original further for a short time that only the highest lights leave any impression on the plate, then originates a correctly broken up negative with the difference that the dots in the

* The Author assumes this, no doubt, to be commercially obtainable, as probably it may be on the Continent. I have not heard of it in England, but recently saw a formula in a German journal for "Mattolein." It consists of Spirits of turpentine, 5 parts, and dammar, 1 part.—TRANS.

whites are gradually veiled into the entire black. When such a negative is printed the increasing opacity of the veiled dots comes into evidence, and results in small dots of increasing fineness on the metal plate, until the light has no more action on the sensitive film in the parts entirely opaque on the negative. It is not to be denied that in this way very nice gradations are obtained, but unfortunately the lights in the drawing are rendered pure white, and this under some circumstances is a great disadvantage of the process, against which there is no remedy, unless the artist in the drawing itself gives the lights within the drawing more tone than in the background of the vignette. With a Levy's patent half-tone dark slide with screen regulated from the outside, I have attained the closing up of the lights in a better manner, by putting the cap on the lens after the regular exposure, introducing a large stop and removing the screen to its furthest distance, then exposing further for a very short time.* The resulting action is, according to what I have said in the chapter on negative making, quite comprehensible.

* Such a method is readily attainable by means of the screen adjustment gear, which is now generally in use in England.—TRANS.

CONCLUSION.

I have endeavoured in the foregoing chapters to describe as comprehensively as possible the entire process of half-tone engraving, from the retouching of the original at the outset, to the blocking of the plate, so that this book may serve even the beginner as a guide to a successful result. Many other things seemed to me to be worthy of attention, had I not been afraid, that through methods which lay a little out of the direct way, I should encroach upon the one process represented in these lines. Everywhere are rising up new methods, suggestions and experiments being made, and other processes striving to come to light and to overcome the until now unconquered screen. How many years will it last, before we stand at a new turning point in the history of half-tone? Who can tell? But so long as new experiments stand alone and untested, so long must they be without the sanction of business practice. I hesitate to take them up in this little book, for not one of the modified processes indicated is likely to achieve such fame as to surpass in beauty, and at the same

time in certainty and speed, those I have described. It is this trinity of advantages which makes the strength of the half-tone process.

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TO

ILLUSTRATE THE PROCESS

OF

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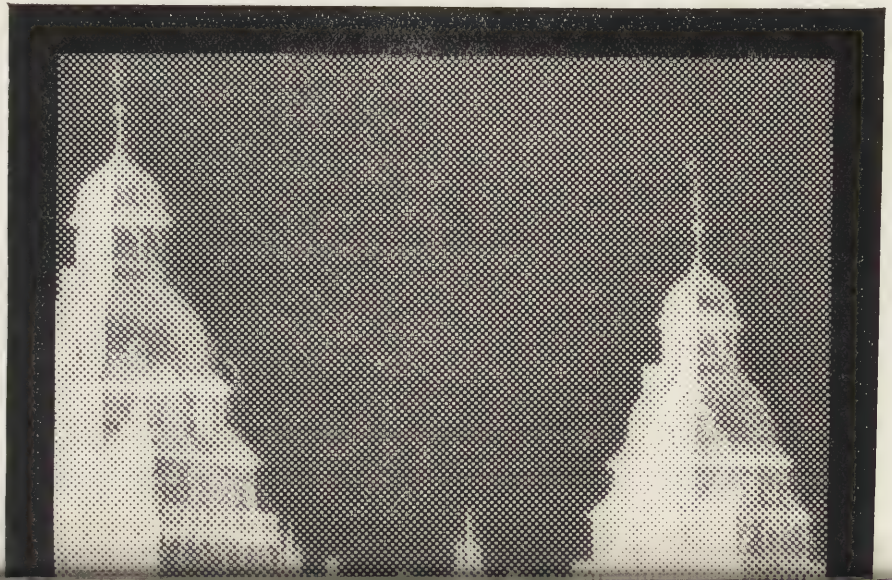

VI. Sixteen times superficial enlargement of a Half-Tone Negative to demonstrate the breaking-up of the High-Lights, Half-Tones and Shadows.

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HALF-TONE